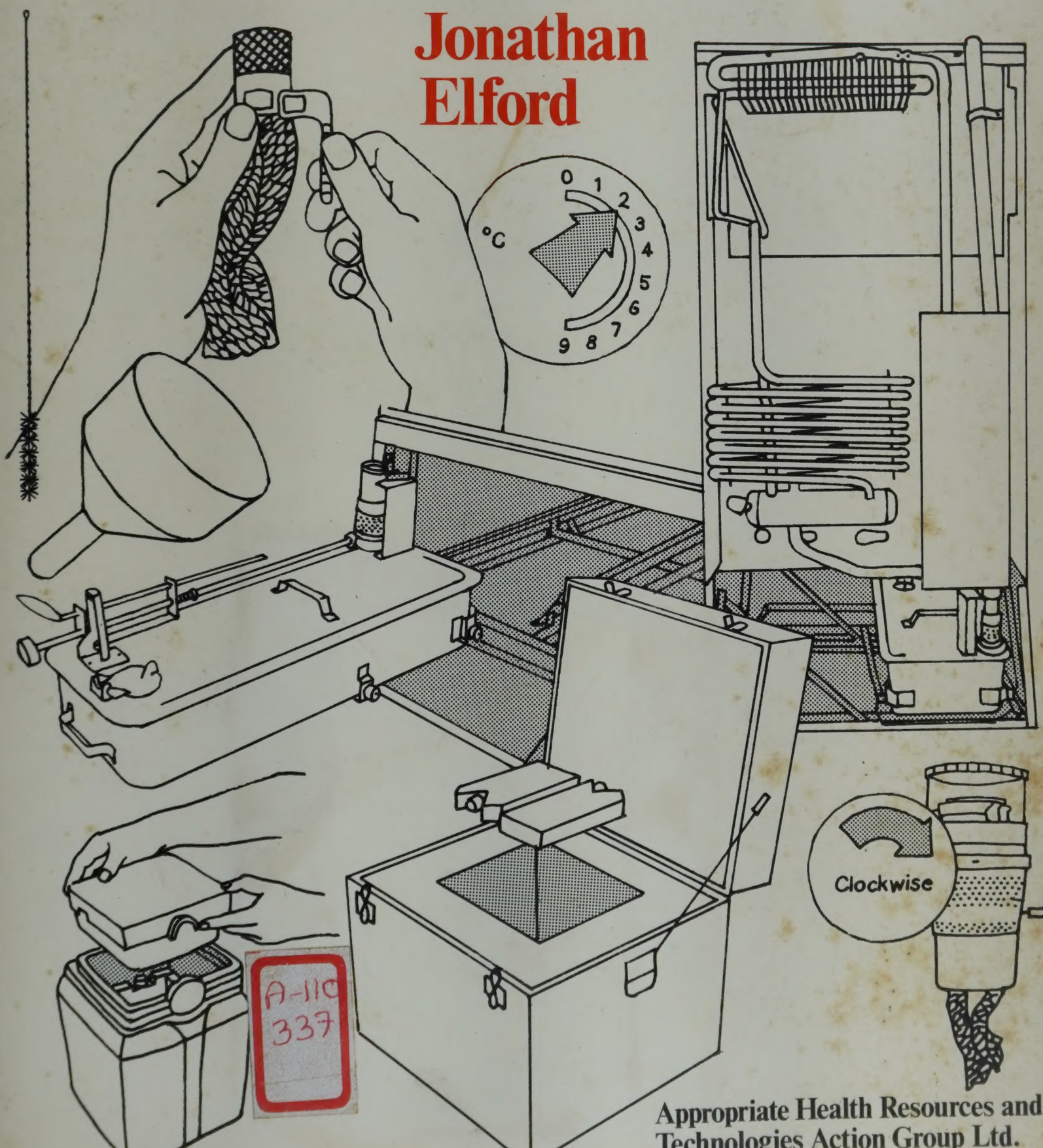
# How to look after a refrigerator

Jonathan Elford

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Appropriate Health Resources and Technologies Action Group Ltd.

**Readers' comments on the first edition of** *How to look after a refrigerator . . .*

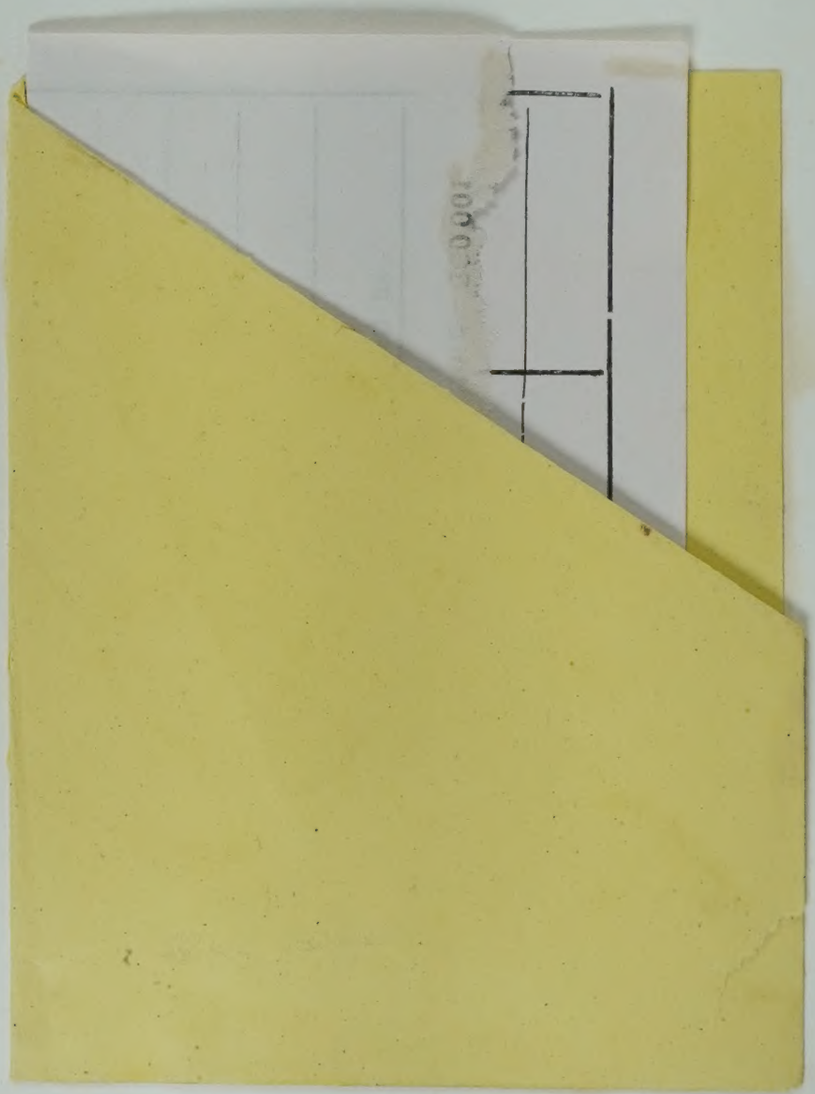
*"The section on vaccines was very helpful"*
(Esther Knoll, Hospital de Kibogora, B.P. 31, Cyan Gugu, Rwanda)

*"Very good book – I ordered 200 copies and distributed them throughout Papua New Guinea"*
(Garry T. Presthus, World Health Organization, Box 2932, Manila, Philippines)

*"Thank you"*
(Martha Desrosiers, P.O. Box 635-A, Quito, Ecuador)

*"The contents of the book are extremely well presented: big and neat text and illustrations – just as is necessary for people like VHW's at primary level. Your book is top quality!"*
(Hildegard Bromberg Richter, Caixa Postal 20833, 01000 Sao Paulo, Brazil)

*"It proves practical with illustrations and simple explanations. Many thanks"*
(Good Shepherd Hospital, P.O. Box 2, Siteki, Swaziland)



# How to look after a refrigerator

COMMUNITY HEALTH CELL

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Bangalore - 560 001.

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**How to look after a refrigerator**


| | |
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I would like to thank them all.

# Introduction

Nothing is of greater importance for the future of the world than the proper care of its children. Much can be done to protect their health through vaccination against infectious diseases. There is no need for children to die or suffer from measles, polio, tuberculosis, tetanus, whooping cough and diphtheria. There are vaccines nowadays which prevent these illnesses. All children, wherever they live, should be given vaccines so that they can grow up as strong and healthy as possible.

Vaccines need to stay cool all the time. If they are allowed to get hot they become useless. Refrigerators keep vaccines cold and safe. Therefore, they play a very important part in protecting children against infectious diseases. But refrigerators break down easily, so they must be carefully looked after to keep them working properly. Jonathan Elford has written this book to help people look after refrigerators.

Sections 1, 2, 3 and 4 can be used for training people in small groups. Most refrigerators in developing countries run on kerosene. A training course on the care of kerosene refrigerators, based on this book, should take two days. During the training, the students should practice on the type of refrigerator they will look after.

People learn how to change the wick best by doing the job themselves, not by watching somebody else. Even without a teacher, this book makes it easy for people to teach themselves how to use a refrigerator properly.

This is also a reference book to remind people how to keep the refrigerator working well and what to do if it breaks down. People should use sections 5 and 6 after they have been trained to care for the refrigerator correctly. The refrigerator needs attention every day to keep the vaccines safe. If it breaks down, there are things that can be done to make it work again and to protect the vaccines. Vaccines are expensive and must not be wasted. They save children's lives.

Vaccines often have to be carried from one place to another. The vaccines can travel safely for several days in cold boxes and vaccine carriers. It is the job of the person who looks after the refrigerator to fill the vaccine carriers and cold boxes. Section 7 describes how to do this.

We hope that this book will be really useful to everyone who is responsible for a refrigerator and vaccines. We want to help them to do their job properly so that children all over the world can be vaccinated and not suffer from diseases like polio, measles and tuberculosis. Vaccines are no use without a refrigerator, and a refrigerator, like a child, needs a lot of special care and attention.

Katherine Elliott

# Contents


| | | Page |
|---|---|---|
| **Section 1** | **Your refrigerator** | 1 |
| **Section 2** | **The best position for your refrigerator** | 6 |
| **Section 3** | **How to make your refrigerator work** | |
| | Kerosene (absorption) refrigerators | 8 |
| | Electric (absorption) refrigerators | 27 |
| | Gas (absorption) refrigerators | 30 |
| | Electric (compression) refrigerators | 36 |
| **Section 4** | **Inside the refrigerator** | |
| | Where to keep the vaccines inside the refrigerator | 38 |
| | How to keep the inside of the refrigerator cold | 40 |
| **Section 5** | **How to look after your refrigerator** | |
| | How to look after your refrigerator each day | 41 |
| | How to look after your refrigerator each week | 42 |
| **Section 6** | **What to do in an emergency** | |
| | Kerosene (absorption) refrigerators | 44 |
| | Electric (absorption) refrigerators | 46 |
| | Gas (absorption) refrigerators | 47 |
| | Electric (compression) refrigerators | 48 |
| **Section 7** | **Cold boxes and vaccine carriers** | |
| | Cold boxes | 49 |
| | Vaccine carriers | 53 |
| **Annex I** | Spare parts | 59 |
| **Annex II** | Have your DPT or tetanus toxoid vaccines frozen? | 60 |
| **Annex III** | The cold chain monitor | 62 |

# Section 1

# Your refrigerator

Every year infectious diseases kill thousands of children in your country. These diseases are polio, measles, tuberculosis, tetanus, whooping cough and diptheria. You can protect children against these diseases if you vaccinate them. Usually you vaccinate children against diptheria, whooping cough and tetanus with one vaccine. This is called DPT. The vaccine for tuberculosis is called BCG.

All vaccines lose their strength very quickly when they become hot. They are then useless and cannot protect children. Therefore you must always keep your vaccines cold. Refrigerators, cold boxes and vaccine carriers do this. This equipment is an important part of the cold chain. You must look after it very carefully.

## How a refrigerator works

Your refrigerator is very important. You should know how it works.

Look at the back of your refrigerator. You can see many pipes. Touch them. They are hot. Inside these pipes there is a special liquid. This is the refrigerant. It moves continuously through the pipes and keeps the inside of the refrigerator cold.

The refrigerant takes heat out of the inside of the refrigerator and throws it out at the back. That is why the pipes are hot. These pipes are delicate and so you must not treat them roughly.

In the walls and door of a refrigerator is a special thick material. This material keeps cold air in the refrigerator and hot air out. It is called insulation.

When you open the refrigerator door, some cold air escapes. Some hot air gets in and the refrigerator becomes warm inside again. Therefore open the refrigerator door only for a short time when you are using it.

# There are different types of refrigerators

**Compression refrigerator**

At the back of a compression refrigerator there is an electric motor. This is called a compressor. The compressor pushes the refrigerant through the pipes at the back of the refrigerator. This keeps the inside of the refrigerator cold. A compression refrigerator only uses electricity and needs a continuous supply.

**Absorption refrigerator**

At the back of an absorption refrigerator there is a heating unit. This unit produces heat, which pushes the refrigerant through the pipes. This keeps the inside of the refrigerator cold.

There are three types of heating units and therefore there are three types of absorption refrigerators. They are:

| | |
|---|---|
| **1. The kerosene (or paraffin) refrigerator** | The heating unit is a kerosene (or paraffin) burner. |
| **2. The gas refrigerator** | The heating unit is a gas burner. |
| **3. The electric refrigerator** | The heating unit is an electric element. |

An electric element is different from a compressor.

Paraffin is another name for kerosene. In this book the fuel is called kerosene.

Most of the information in this book is about absorption refrigerators, because many offices and clinics have them. There is also information about compression refrigerators.

# All refrigerators have some things in common

In absorption and compression refrigerators there are two areas for storage.

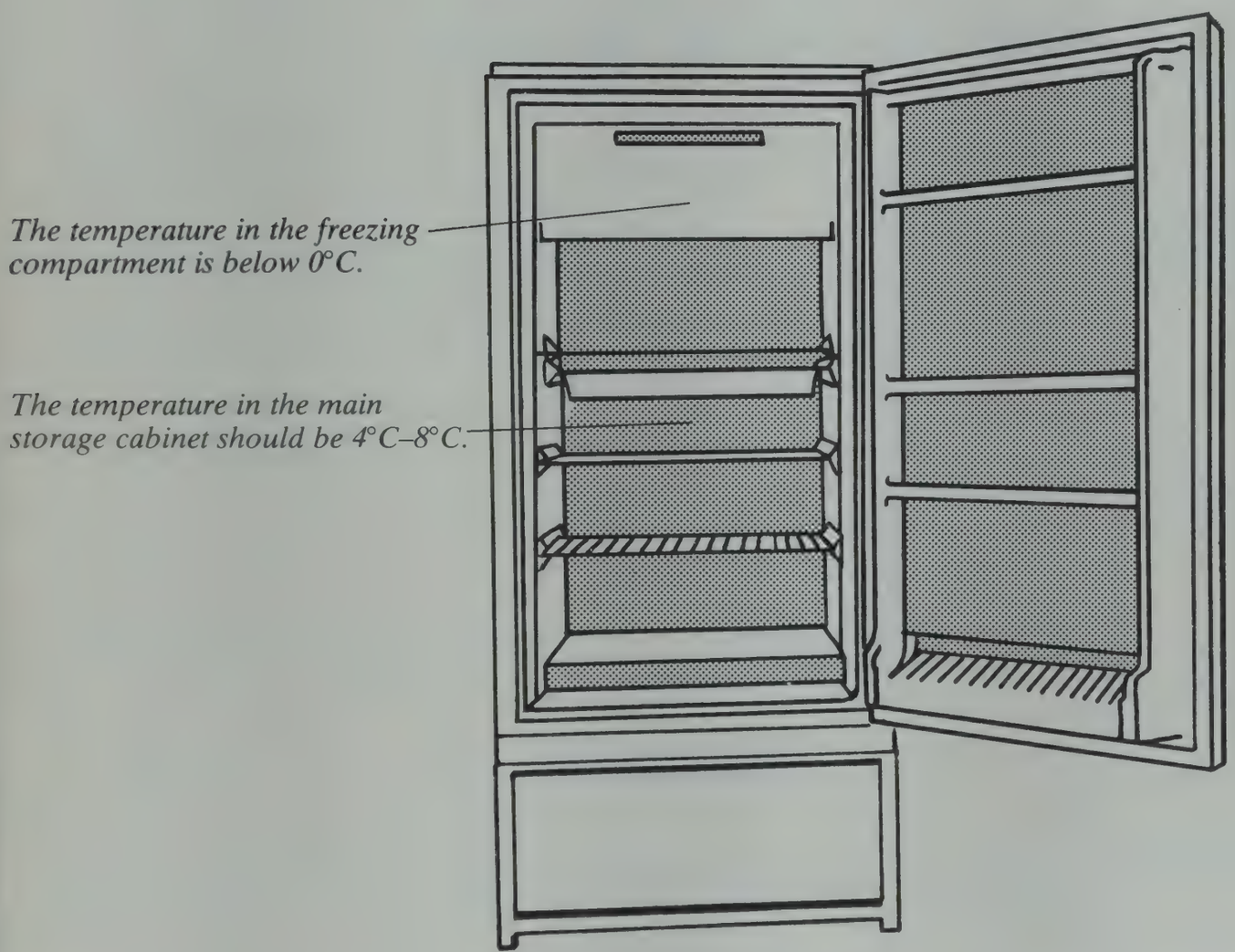
**The main storage cabinet**

In the main storage cabinet the temperature should be between 4°C and 8°C. There are usually two or three shelves in the cabinet.

**The freezing compartment**

This compartment is above the main storage cabinet. Here the temperature is below 0°C. Water freezes at 0°C. This means that water turns into ice at 0°C. Most things you put into the freezing compartment will freeze. The things which you put in the main storage cabinet will become cold, but they should not freeze.

In all refrigerators the heat comes out through the pipes at the back.




On some new refrigerators, the door is on the top and not at the front. In all the pictures in this book, the door opens at the front of the refrigerator.

# Absorption refrigerators

In kerosene and gas refrigerators there is a flame which produces heat. This heat pushes the refrigerant through the pipes, which makes the inside of the refrigerator cold.

In the electric refrigerator the electric element produces the heat, which pushes the refrigerant through the pipes. This makes the inside of the refrigerator cold.

When the heating unit produces a lot of heat, it pushes the refrigerant through the pipes quickly. This takes more heat from the inside of the refrigerator and so the refrigerator becomes colder inside.

Therefore when you want the inside of the refrigerator colder, you increase the amount of heat which the heating unit produces. When you want it warmer, you reduce the amount of heat which the heating unit produces.

# How to control the heat

The three types of absorption refrigerator have different heating units. In each type the way you control the heat is different.

**Kerosene refrigerators**

Under the main storage cabinet there is a fuel tank, with a kerosene burner and a wick. Remember, a large flame produces a lot of heat.

A lot of heat pushes the refrigerant through the pipes quickly. This makes the refrigerator colder.

*A large flame makes the refrigerator colder.*

A small flame produces less heat. This makes the refrigerator warmer. A special knob controls the size of the flame. You turn this by hand.

*A small flame makes the refrigerator warmer.*

**Gas refrigerators**

Under the main storage cabinet there is a gas burner. A special dial controls the amount of heat which the burner produces. This dial is the thermostat. It usually has numbers on it.

In order to change the temperature inside the refrigerator you turn the dial.

**Electric refrigerators**

Under the main storage cabinet is an electric element. When electricity runs through the element it produces heat. A dial controls the amount of heat which the element produces. This is the thermostat. It usually has numbers on it.

You can turn the dial to change the temperature inside the refrigerator.

Remember, the temperature in the freezing compartment should be below 0°C, and the temperature in the main storage cabinet should be between 4°C and 8°C.

# There are different sizes of refrigerators

Some refrigerators are bigger than others. If you store a lot of vaccine you need a big refrigerator. Therefore you will need a small refrigerator if you keep a small amount of vaccine.

A big refrigerator needs more refrigerant to keep it cold than a small one. If you have more refrigerant, you need more heat to push the refrigerant through the pipes. For this you need more fuel. Therefore a big refrigerator needs more kerosene, gas or electricity to keep it cold inside.

Some manufacturers classify their refrigerators by letters and numbers e.g. the Electrolux RAK 66. The manufacturer measures the amount of storage room inside the refrigerator. This is called the gross internal volume. The measurement of this volume is in litres or in cubic feet.

Here are the sizes of some refrigerators.

| **Type of refrigerator** | **Gross internal volume of the main storage cabinet** | |
|---|---|---|
| | **litres** | **cu. ft.** |
| Electrolux RAK 100 | 150 | 5.3 |
| Electrolux RAK 66 | 90 | 3.2 |
| Electrolux RAK 36 | 60 | 2.1 |

# Section 2

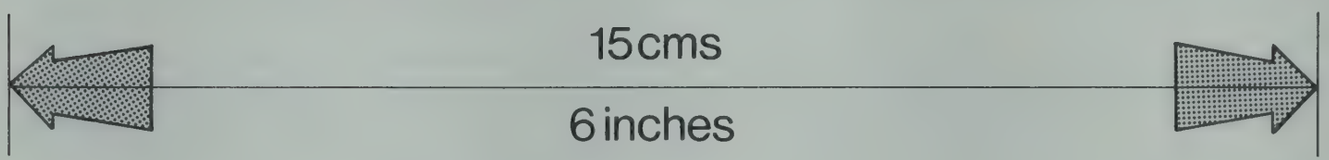
# The best position for your refrigerator

The position of your refrigerator is very important.

**1.** Keep your refrigerator in the coldest room in the clinic.
Keep the refrigerator out of the sunlight and away from all heat.

**2.** Keep your refrigerator in a room which you can lock.
Always leave the key of the room in a safe place in your office or clinic.

**3.** Your refrigerator must be 15 cm (6 inches) from the walls.
This allows hot air to escape from the back of the refrigerator. The hot air from the refrigerator makes the room warm. So there must be a ventilator or extractor fan in the room.




**4.** Wind from the window or door can blow out the flame in gas or kerosene refrigerators. So keep them away from draughts.

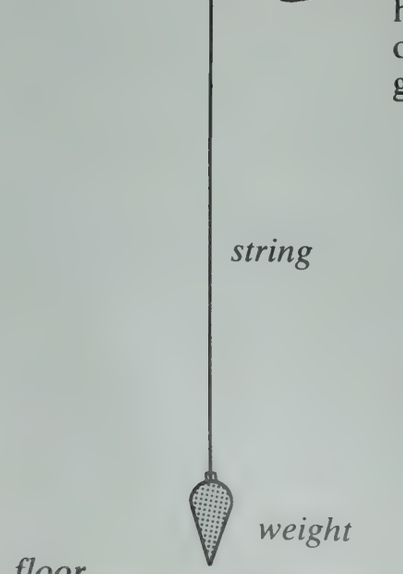
**5.** Your refrigerator must always be level. When a refrigerator is not level, the refrigerant cannot move easily through the pipes. Then the inside of the refrigerator becomes warm.

Many refrigerators have legs which you can make shorter or longer. You turn the legs like screws to make the refrigerator level. Some refrigerators do not have legs like this. You can put a piece of wood or paper under one of the legs of your refrigerator to make it level.

The best way to check that your refrigerator is level is to use a plumb line.

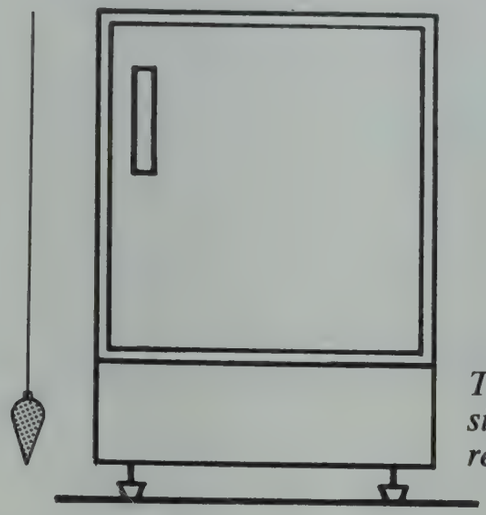
## The plumb line

A plumb line is a piece of string with a small heavy weight on the end. You can easily make one yourself. You need a piece of string 1 metre long (3 feet) and a weight of about ½ kg (1 lb) with a small hook on the top. Tie one end of the string to the weight. Hold the other end of the string and let the weight hang freely above the ground.



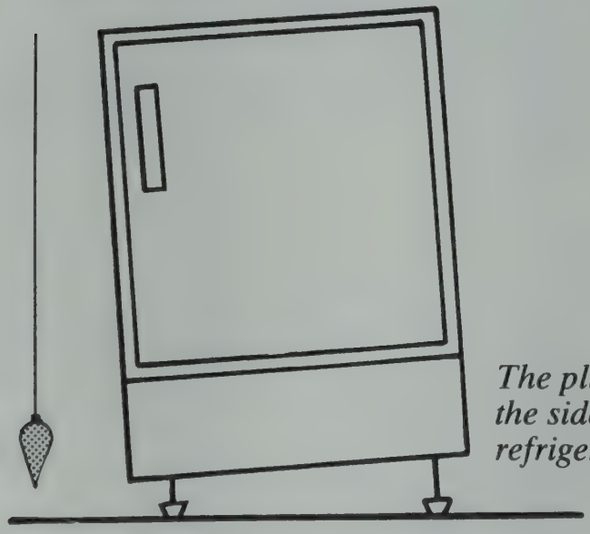
# How to use the plumb line

If the refrigerator is level the plumb line will be parallel with the side and the front of the refrigerator. To check this you need two people. One person holds the plumb line near the side or the front of the refrigerator. The other person stands 1 metre (3 feet) away to check that the plumb line and side or front are parallel.



*The plumb line is parallel with the side of the refrigerator. The refrigerator is level.*

**1.** If the side of the refrigerator is not parallel with the plumb line, make the legs shorter or longer.



*The plumb line is not parallel with the side of the refrigerator. The refrigerator is not level.*

Now check if the side and the plumb line are parallel.

**2.** If the front of the refrigerator is not parallel with the plumb line, make the legs shorter or longer.

Check that the side and plumb line are parallel.

**3.** Check the side and then the front again.

# Section 3

# How to make your refrigerator work

## Kerosene (absorption) refrigerators

## Contents


| **The fuel tank** | **Page** |
|---|---|
| How to remove the fuel tank | 10 |
| How to clean the fuel tank | 13 |
| How to fill the fuel tank | 13 |
| How to put the fuel tank back under the storage cabinet | 14 |
| **The burner** | |
| Description of the burner | 17 |
| How to remove the burner from the tank | 19 |
| How to clean the burner | 19 |
| How to trim the wick | 20 |
| How to change the wick | 20 |
| How to light the burner | 24 |
| How to control the temperature | 24 |
| **The flue and baffle** | |
| Description | 25 |
| How to clean the flue and baffle | 26 |

# Kerosene (absorption) refrigerators

There are different models and sizes of kerosene refrigerators. They all have a heating unit, which produces the heat to push the refrigerant through the pipes. This makes the refrigerator cold.

Under the main storage cabinet of the refrigerator is the fuel tank and the heating unit, which is a burner. At the back of the refrigerator is a flue and baffle.

**The fuel tank**

The fuel tank slides out from under the main storage cabinet. On top is a cap which you remove to fill the tank with kerosene. There is also an indicator which shows how much kerosene is in the tank. In some refrigerators the fuel tank slides out at the side.

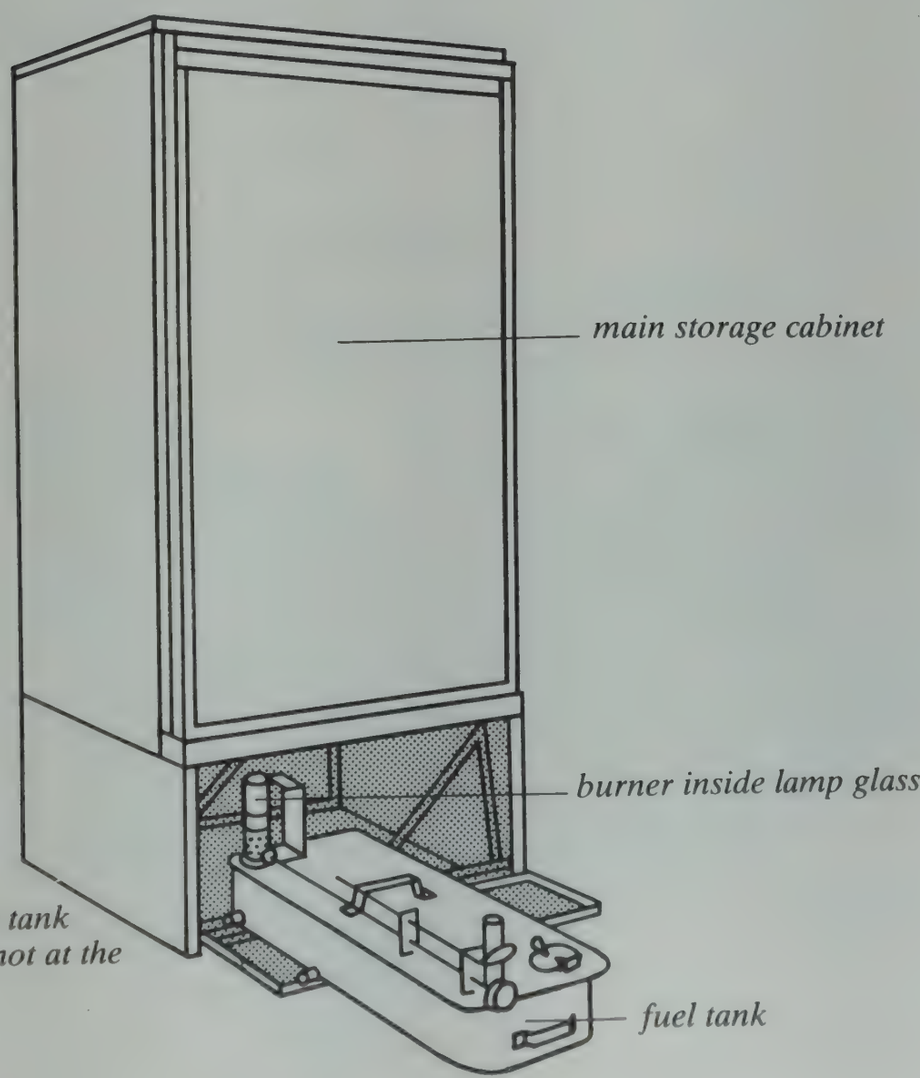
**The burner**

At the back of the tank is the burner. It has a wick which burns inside a lamp glass. There is a knob which you turn to raise or lower the wick.

**The flue and baffle**

The flue is a metal tube at the back of the refrigerator, through which the hot air from the burner rises. The burner must be exactly under the flue.

The baffle is a piece of twisted metal on the end of a long piece of wire. It hangs inside the flue and helps the hot air to rise up the flue.




*On some refrigerators the tank slides out at the side and not at the front.*

# The fuel tank

## How to remove the fuel tank

**Fuel tanks which slide out at the front of the refrigerator.**

The Electrolux RAK 66 and RAK 100 slide out at the front.

**1.** Clear the floor in front of the refrigerator.

**2.** Get down on your knees in front of it.

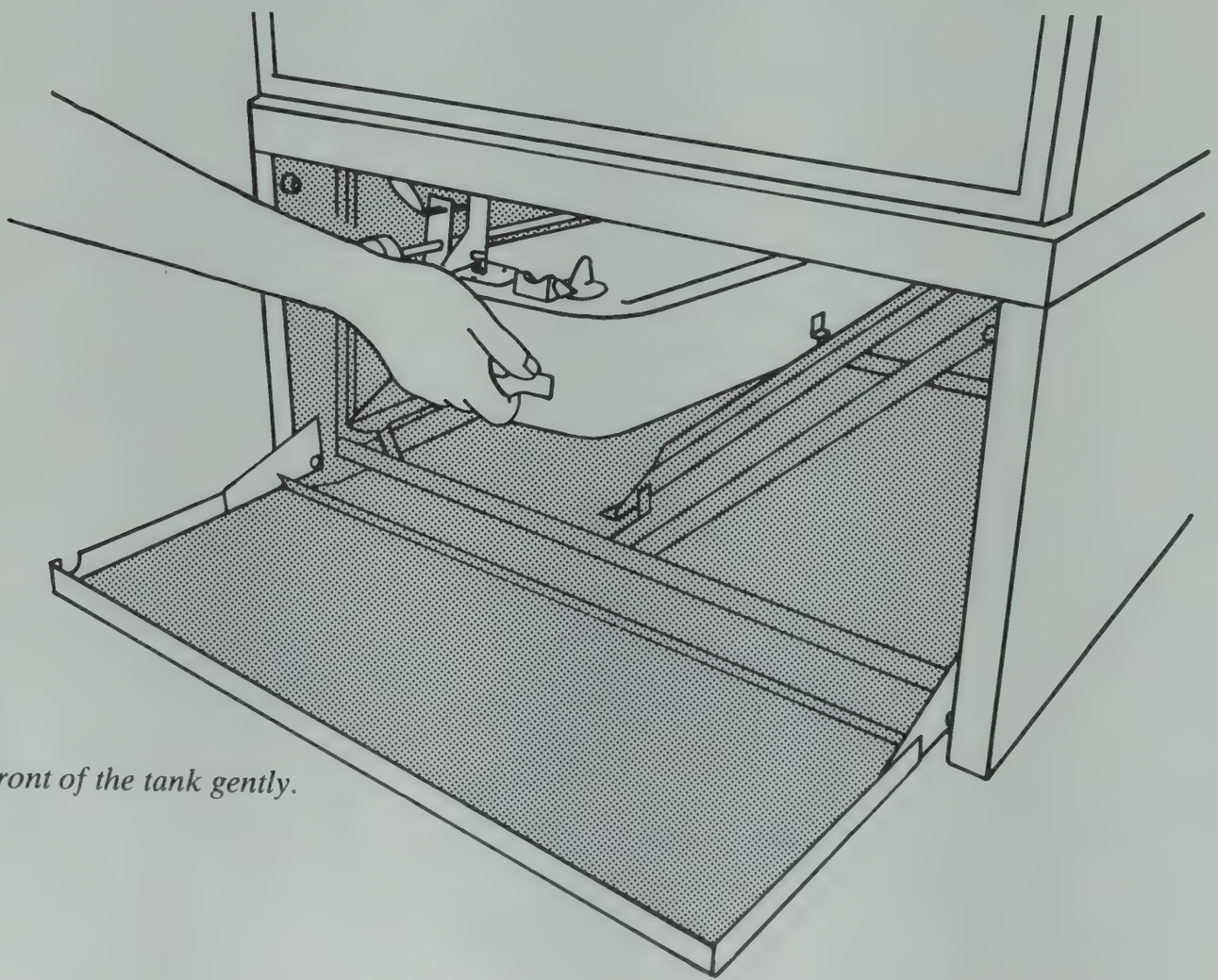
**3.** Open the door under the main storage cabinet.

**4.** Turn out the flame of the burner, if it is lit. To do this turn the control knob anti-clockwise. This lowers the wick and turns out the flame.

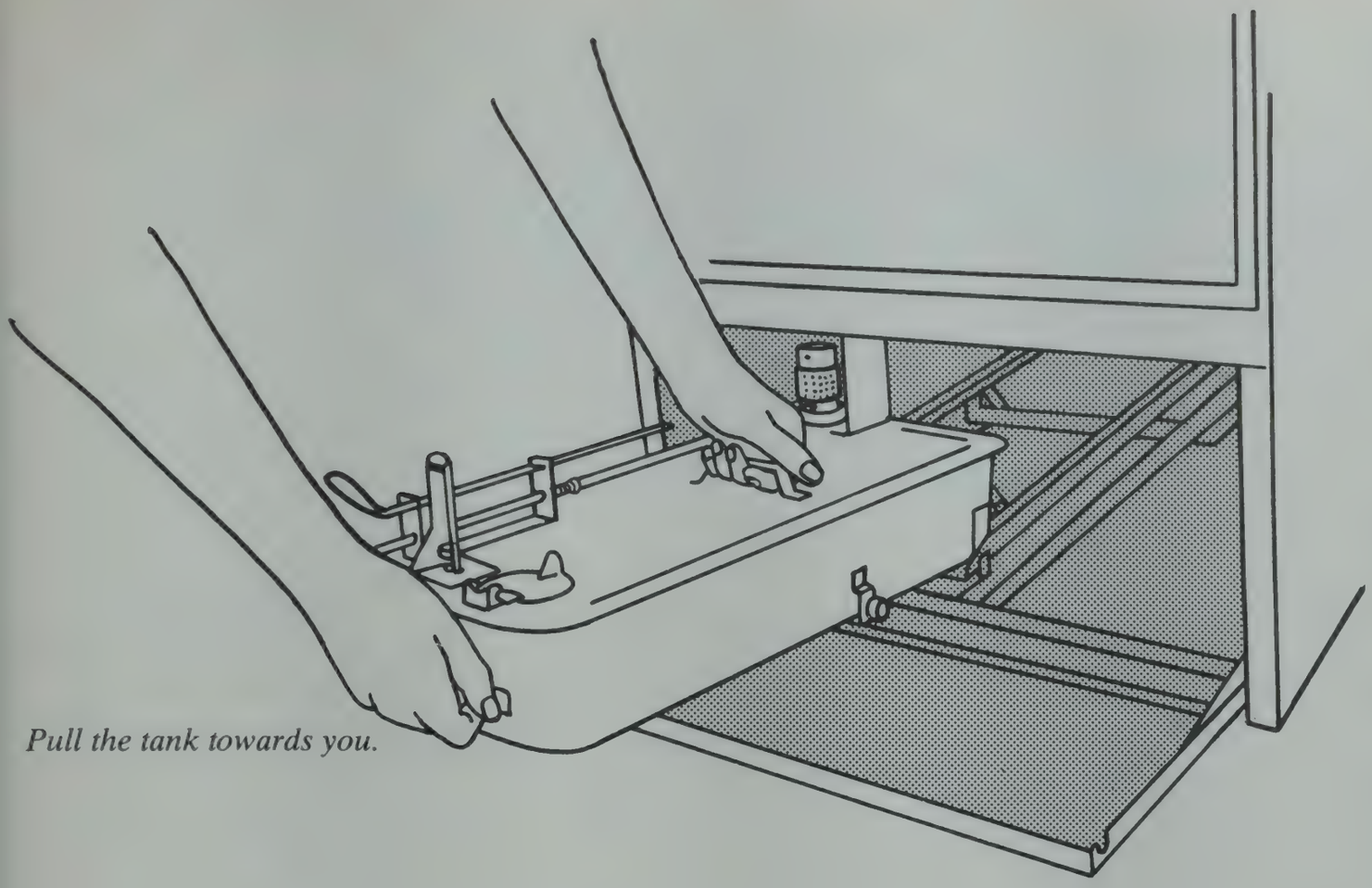
**5.** With the handle lift the front of the tank very gently. This allows the lamp glass to come out from under the flue.

**6.** Pull the tank towards you gently, until it comes out from under the main storage cabinet. The tank moves on little wheels.

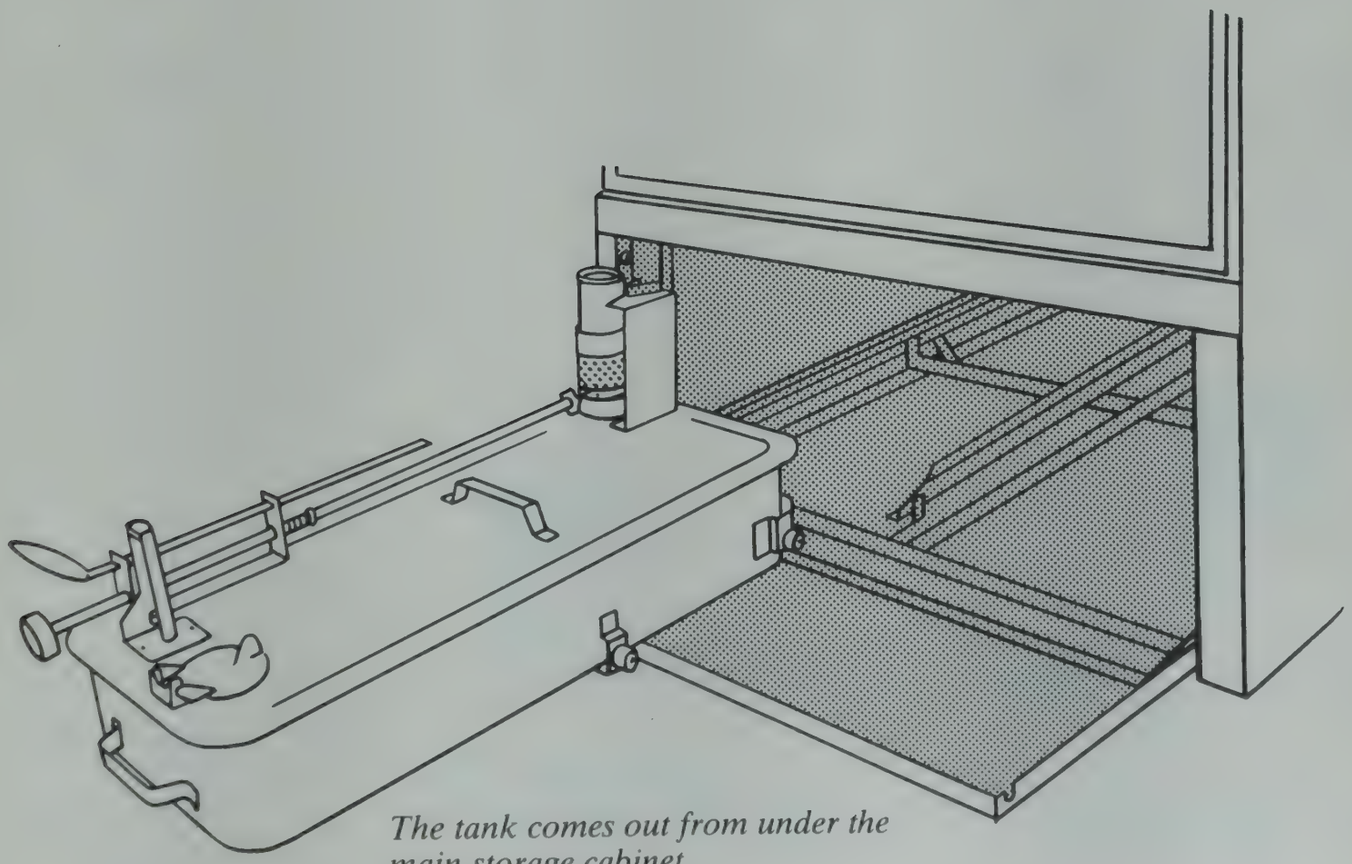
**7.** There is a control knob and metal rod, which is connected to the burner. Before you take the burner out of the tank pull the control knob towards you. This removes the metal rod from the burner.



*Lift the front of the tank gently.*



*Pull the tank towards you.*



*The tank comes out from under the main storage cabinet.*

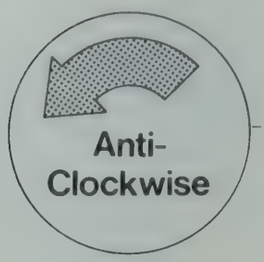
**Fuel tanks which slide out at the side of the refrigerator.**

The Electrolux RAK 36 slides out at the side.

**1.** Clear the floor at the side of the refrigerator.

**2.** Get down on your knees at the side.

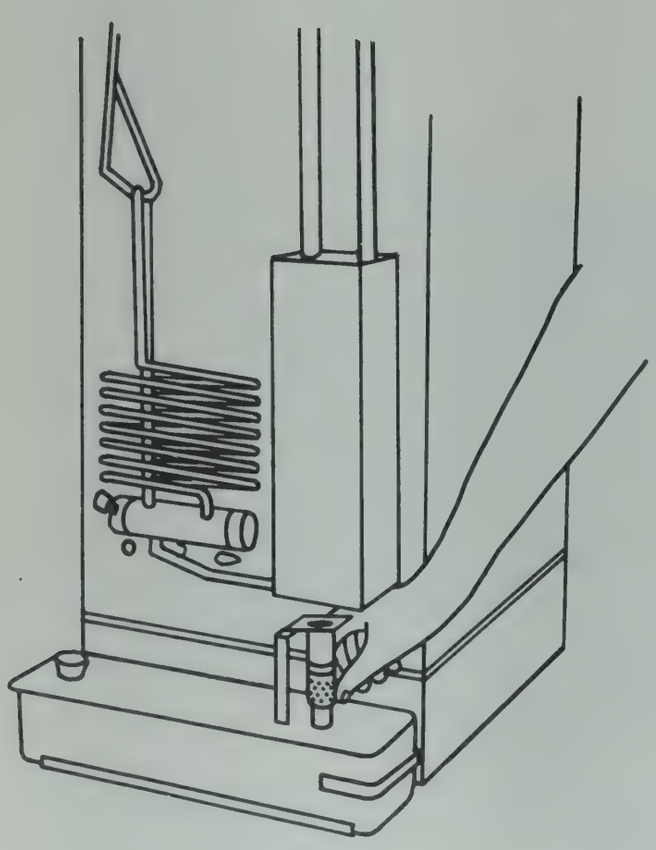
**3.** Turn out the flame if it is lit. To do this turn the knob on the burner anti-clockwise. This lowers the wick and turns out the flame.



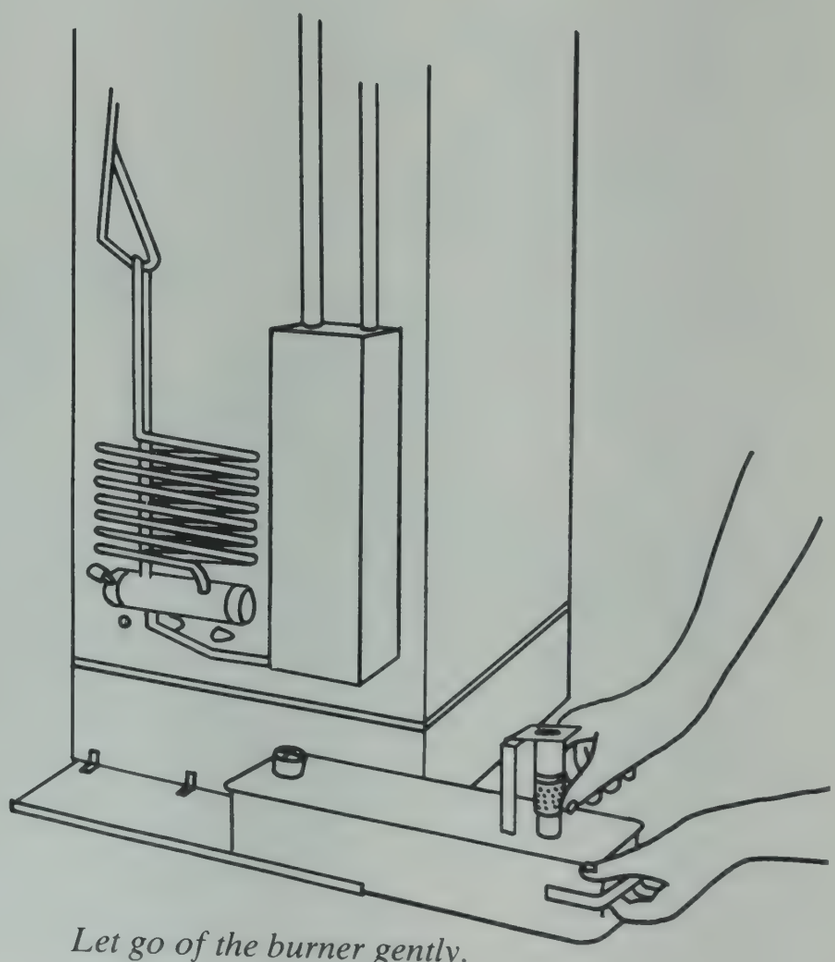

**4.** Wait five minutes for the burner to cool.

**5.** Push the burner down very gently. This allows the burner to come out from under the flue. Be careful. The lamp glass is very delicate.

**6.** Continue to push the burner down gently. With the handle pull the tank out from under the refrigerator.



*Push the burner down and slide the tank along the tray.*



*Let go of the burner gently.*

## How to clean the fuel tank

You must always keep the inside of the fuel tank clean.

1. Remove the fuel tank from under the storage cabinet carefully.
2. Take the burner out of the tank.
3. Empty the dirty kerosene from the tank. You must not use this kerosene in the fuel tank again. You can use the dirty kerosene for cooking or lighting.
4. Pour a little clean kerosene into the tank. Shake the kerosene around the tank to wash it out. Pour this kerosene out and do not use it in the fuel tank again. Never use water to clean out the tank.
5. Clean the outside of the tank with a clean cloth and a little clean kerosene.
6. Remove any rust on the fuel tank completely. Use sandpaper or a metal brush. Then paint over this part to protect it.
7. Replace the burner in the tank.
8. You can now fill the fuel tank with clean kerosene.

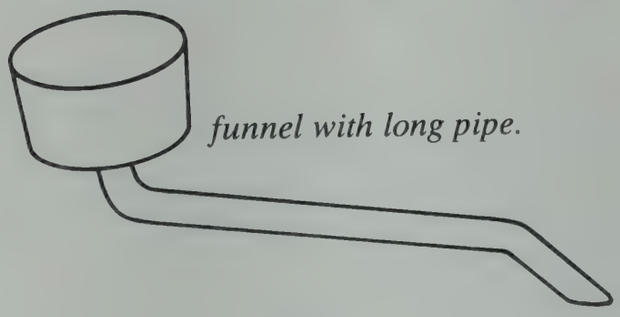
## How to fill the fuel tank

*funnel*

You must only use clean kerosene in the fuel tank. If the kerosene is dirty, the burner produces a lot of smoke. The burner, the flue and the baffle become very dirty. It also damages the wick and so the refrigerator will not work properly.

The kerosene which you buy is dirty. So you must filter the kerosene to take the dirt out. To filter the kerosene place several layers of fine clean cloth inside a funnel. Pour the kerosene into the funnel. The dirt stays in the cloth and the clean kerosene goes into the fuel tank. Always use a funnel when you fill the fuel tank.

Electrolux supplies a funnel with a long pipe for filling the fuel tank. It has a filter as well. If you use this funnel you do not need to remove the fuel tank from under the main storage cabinet. Keep the funnel in a store which you can lock.



*funnel with long pipe.*

1. Remove the tank from under the refrigerator.
2. Place several layers of clean, fine cloth in the funnel.
3. Remove the filling cap.
4. Put the end of the funnel in the opening. If you use the Electrolux funnel you do not have to remove the tank. Remember that you must clean the tank regularly.
5. Pour the kerosene into the funnel slowly.
6. Fill the tank. The indicator on the tank tells you when the tank is full.
7. Remove the funnel and replace the filling cap, so that dirt cannot get into the tank.

Always keep extra kerosene in a store which you can lock. Keep the key at the clinic.

Big refrigerators need more kerosene than small refrigerators.

The following table helps you judge how much kerosene you need each week.

| Type of refrigerator | Amount of kerosene which the refrigerator uses each week. |
|---|---|
| Electrolux RAK 100 | 7 litres (1.5 gallons) |
| Electrolux RAK 66 | 5 litres (1.1 gallons) |
| Electrolux RAK 36 | 4.5 litres (1 gallon) |

The amount of kerosene which each refrigerator uses will differ in every place. Always keep a record of how much kerosene you use each week.

## How to put the fuel tank back under the storage cabinet

The following directions describe how to put back tanks which slide out at the front, e.g. the Electrolux RAK 100 and RAK 66. Page 16 describes how to put back tanks which slide out at the side e.g. the Electrolux RAK 36.

**1.** Place the tank in front of the refrigerator gently.

**2.** Get down on your knees in front of the refrigerator.

**3.** Open the door under the storage cabinet.

**4.** Light the burner. (Read page 24).

**5.** There are metal bars under the main storage cabinet. Always keep these clean. Place the tank gently on the ground in front of these bars. The end with the burner goes in first.

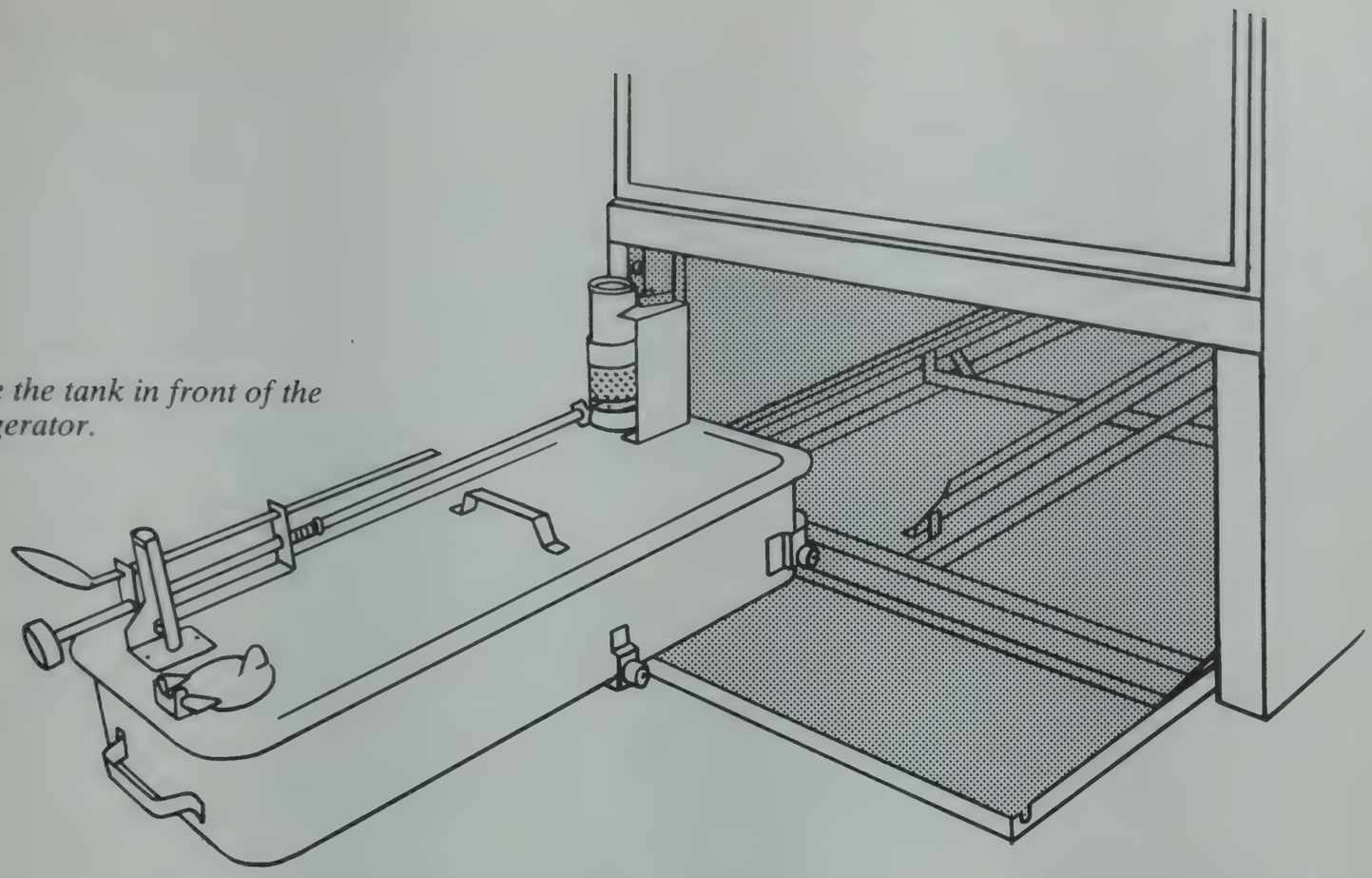
**6.** Lift the tank by the handles and push the tank gently onto the metal bars under the storage cabinet. All the wheels on the bottom of the tank must fit onto the metal bars.

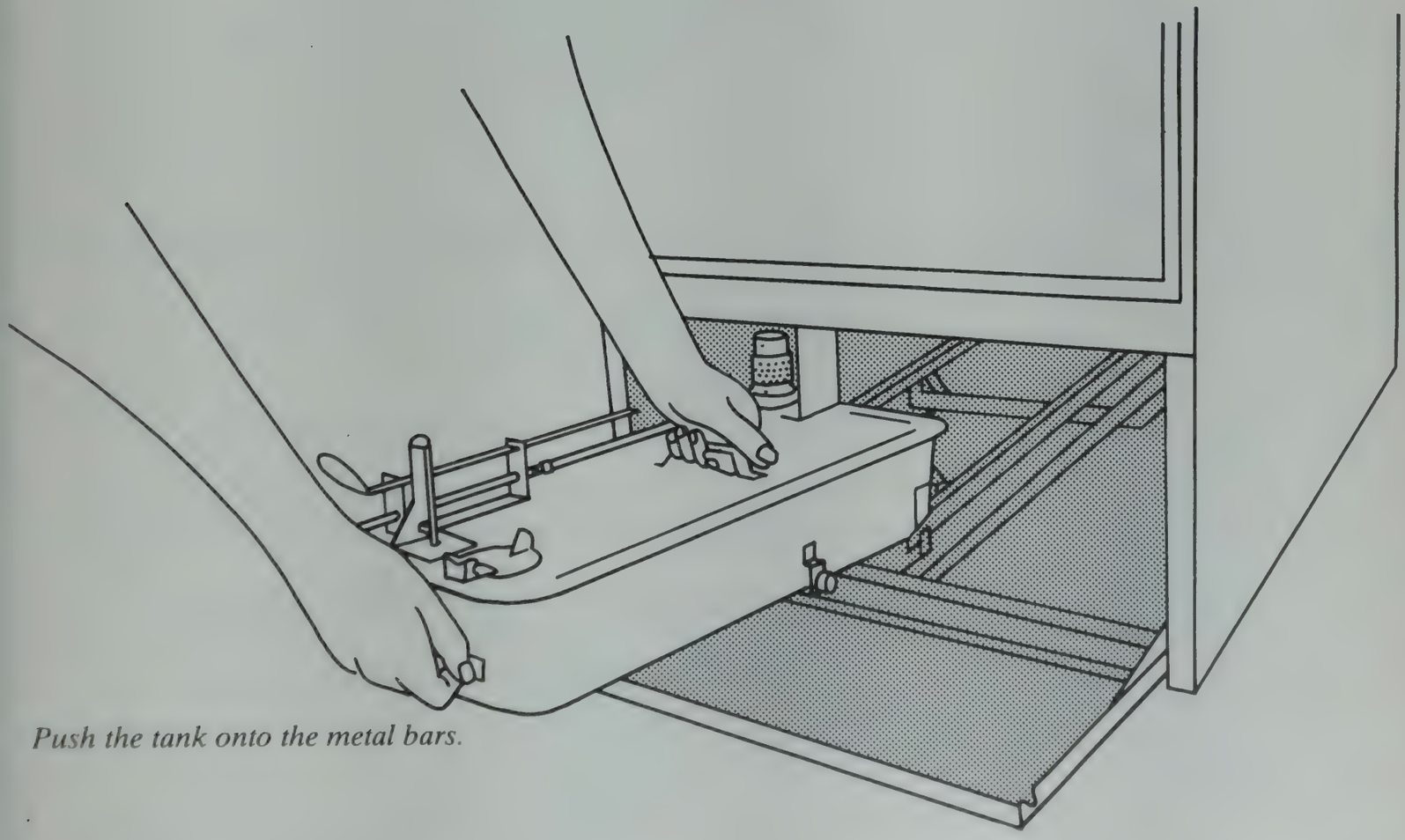
**7.** Hold the handle on the end of the tank and push the tank gently right back under the storage cabinet.

**8.** The end of the tank with the burner now moves up and the burner is directly under the flue. Look at the burner. Move the tank very gently until the lamp glass fits tightly under the flue. Be careful as the lamp glass is very delicate.

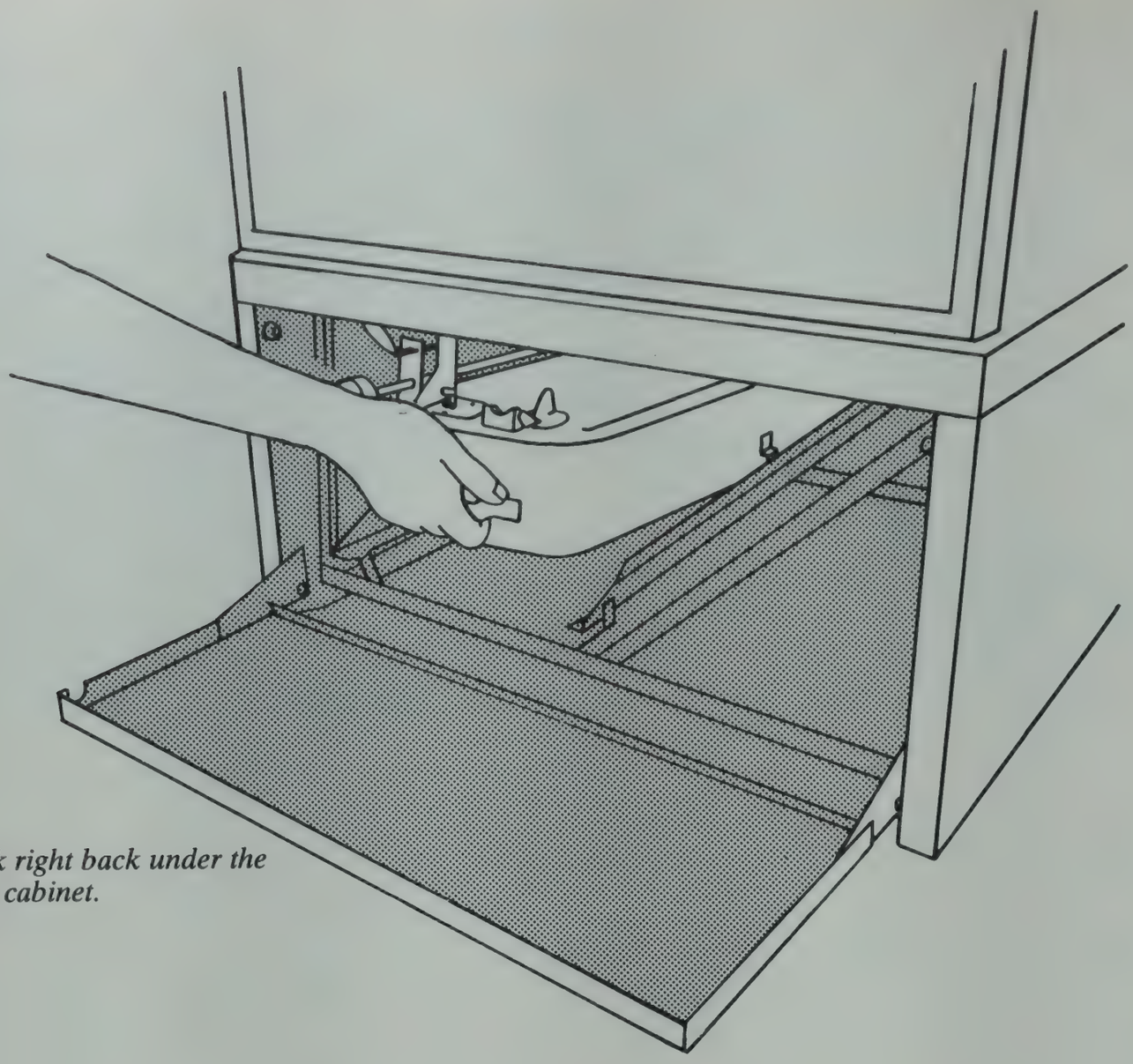
**9.** Small refrigerators like the Electrolux RAK 66 have a yellow flame. Big refrigerators like the Electrolux RAK 100 have a blue flame. Always check that the flame in your refrigerator is the correct colour.

*Place the tank in front of the refrigerator.*





*Push the tank onto the metal bars.*



*Push the tank right back under the main storage cabinet.*

If the tank in your refrigerator slides out at the side, e.g. the Electrolux RAK 36, follow these directions.

**1.** Place the tank at the side of the refrigerator.

**2.** Get down on your knees at the side.

**3.** Light the burner. (Read page 24).

**4.** Lift the end without the burner onto the metal tray at the back of the refrigerator.

**5.** Push the burner down very gently and keep it down. Remember it is hot.

**6.** Slide the tank gently along the metal tray until the burner is exactly under the flue.

**7.** Now let the burner go very gently. It must fit tightly under the flue. Be very careful as the lamp glass is very delicate.

**8.** The flame in the burner should be yellow. Check it.

# The burner

**Description of the burner**

Although there are different sizes of burners they all have things in common:

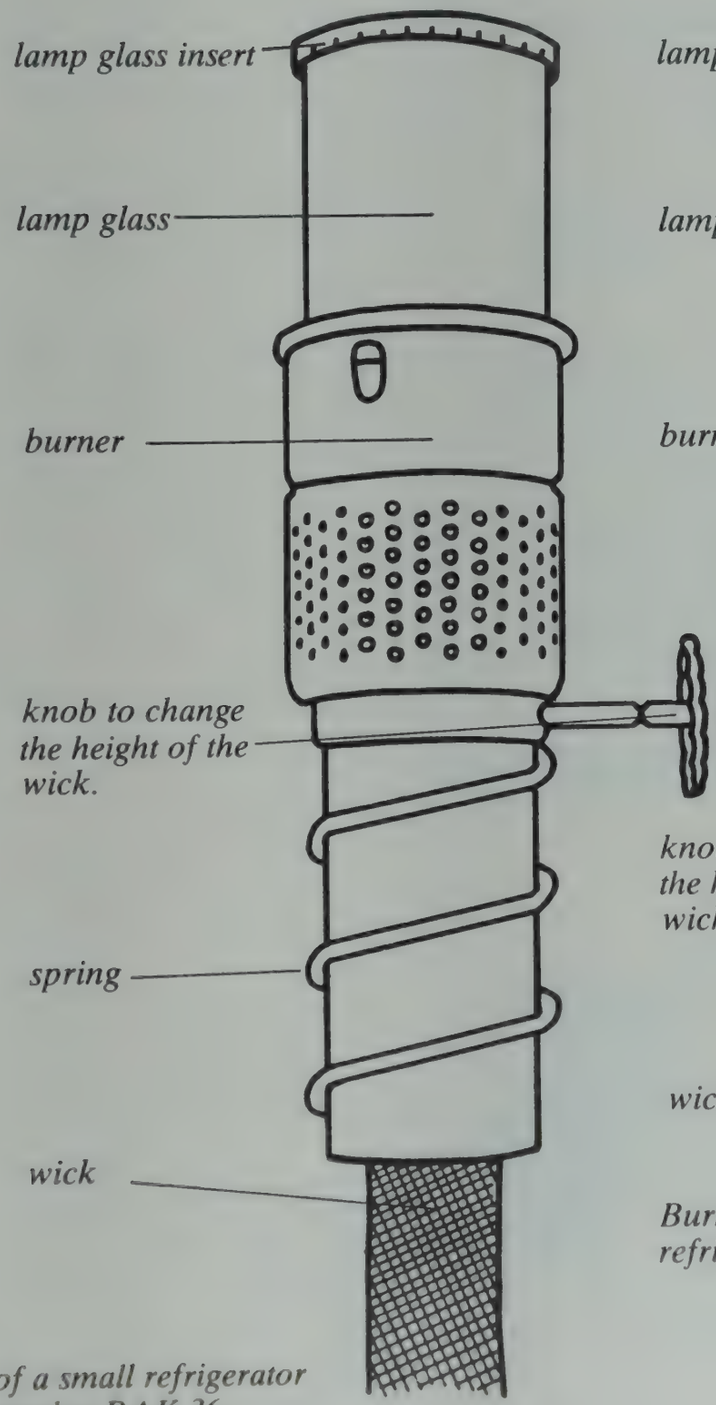
A wick which burns.

A burner with holes in the side, which holds the wick.

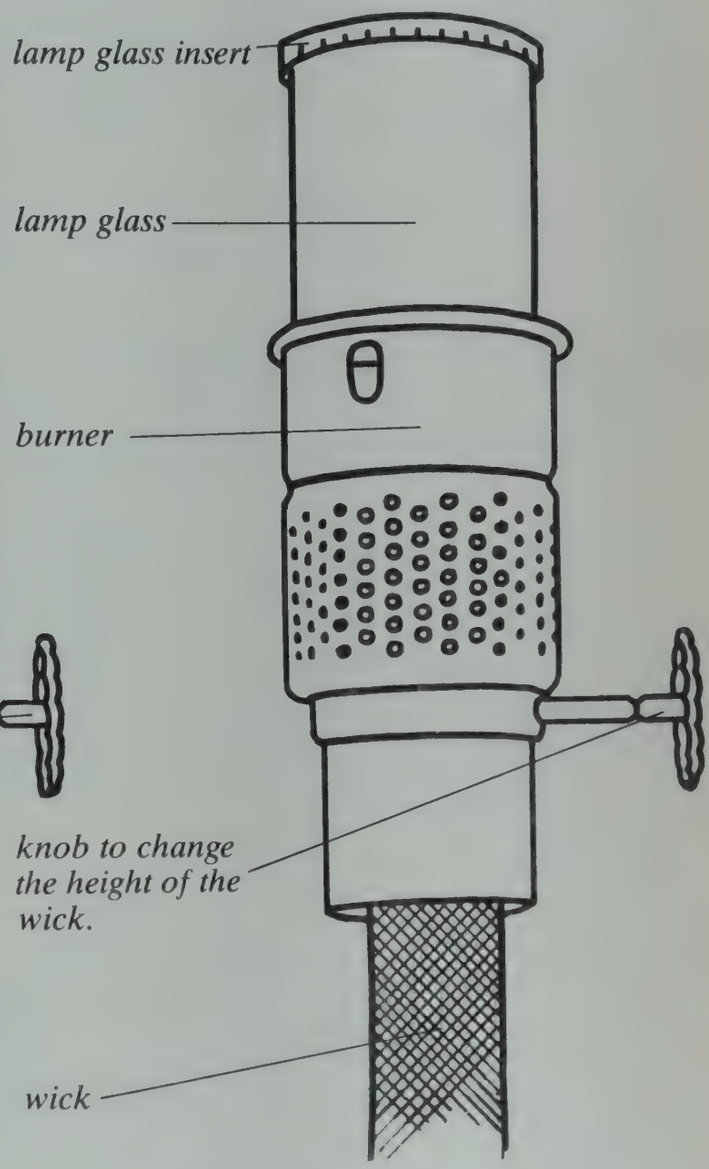
A knob to change the height of the wick.

A lamp glass which surrounds the top of the wick.

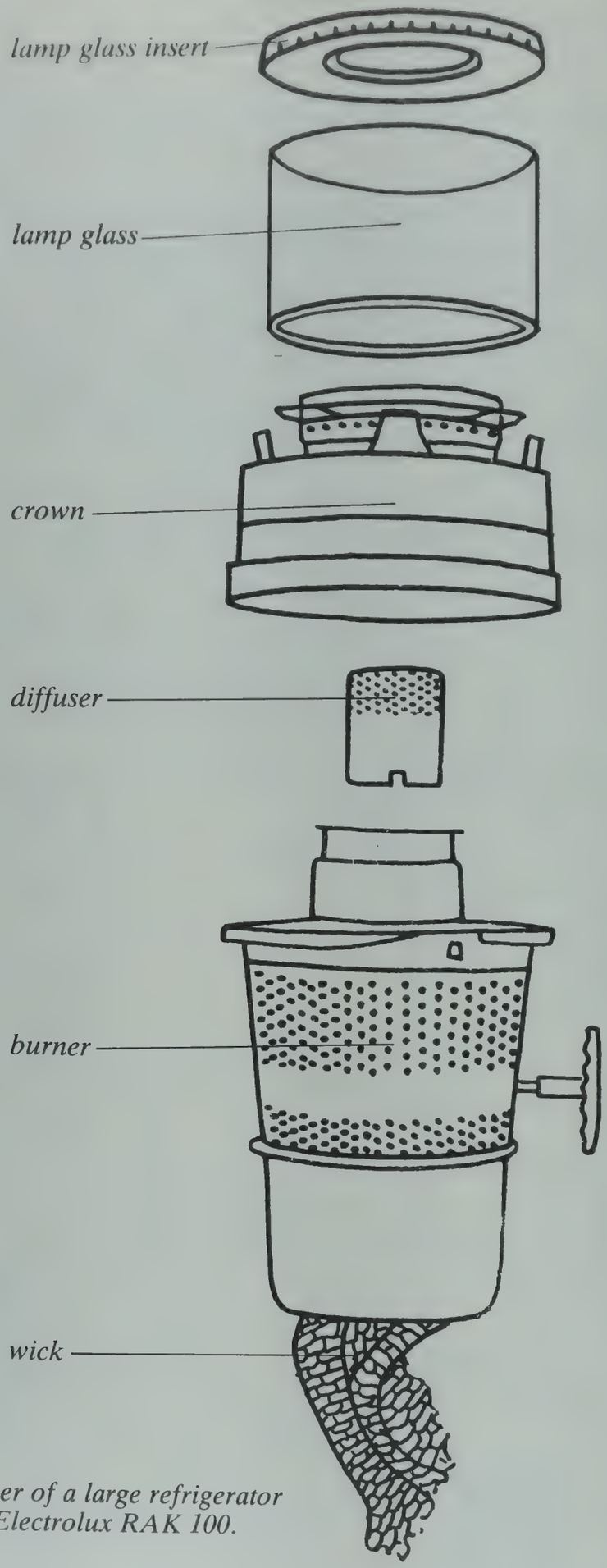
All burners work the same way. The wick takes in the kerosene and burns at the top. The wick needs air to burn. The holes in the burner allow the right amount of air to reach the wick. Dirt in the holes stops air reaching the wick. Then the wick does not burn properly. Keep your burner clean.




*Burner of a small refrigerator e.g. Electrolux RAK 36.*




*Burner of a medium-sized refrigerator e.g. Electrolux RAK 66.*




*Burner of a large refrigerator e.g. Electrolux RAK 100.*

## How to remove the burner from the tank

1. Pull the fuel tank gently out from under the storage cabinet.
2. Turn the knob anti-clockwise to lower the wick and turn out the flame.

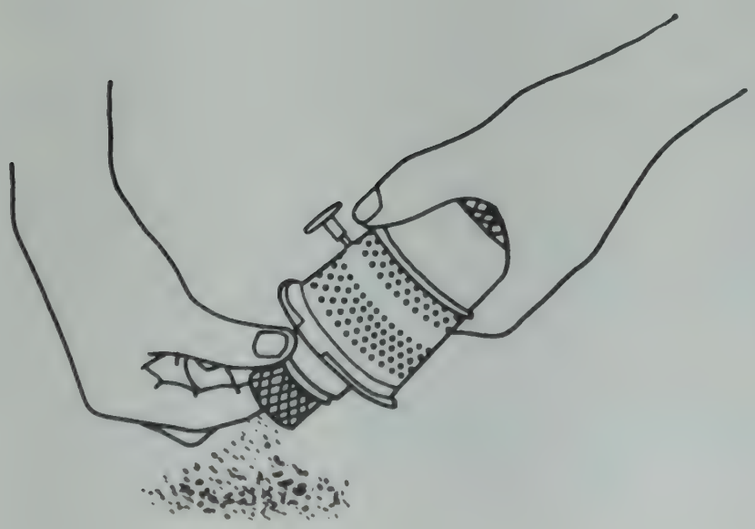
3. The burner is hot. Wait five minutes before you touch it.
4. Lift the lamp glass insert out of the lamp glass.
5. Lift the lamp glass from the burner. If the lamp glass is tight turn it gently. When the glass is loose, take it out gently. Always handle the lamp glass carefully. It is delicate.
6. Clean the lamp glass and lamp glass insert gently with a clean cloth. Put them in a safe place.
7. On the Electrolux RAK 66 and RAK 100 pull the control knob towards you.
8. Now lift the burner from the tank.

Always keep at least four spare lamp glasses.

## How to clean the burner

Dirt in the holes of the burner stops air reaching the wick. The flame then produces smoke. Always keep your burner clean. Use only kerosene to clean it.

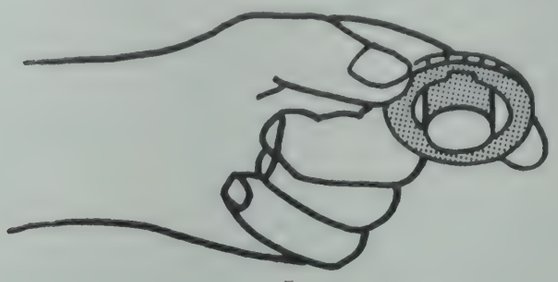
1. Turn the crown on a large burner and lift it off. Remove all the dirt from the holes with a needle. Then wipe the crown with a clean cloth and clean kerosene.
2. Take out the diffuser in a large burner. Remove the dirt from the holes with a needle and wipe it with a clean cloth and kerosene.
3. Hold the burner upside down. Shake it to remove the dirt. Use a needle to clean the holes. Wipe the burner with a clean cloth and kerosene.
4. Hold the burner upside down. Raise the wick about 2 cm (1 inch) and put a finger inside the wick. Gently rub the loose dirt from the edge of the wick.



## How to trim the wick

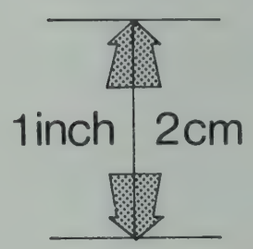
After you clean the burner, trim the wick. If it is not even, it will not burn properly.

The best way to trim a wick is to use a trimmer.



*wick trimmer*

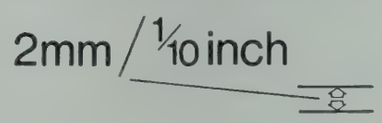
1. Turn the wick down until only the burnt part shows.
2. With scissors or a razor, cut off the burnt part of the wick.
3. Turn the wick up 2 cm (1 inch). Put the trimmer on top of the wick and turn it through half a circle. This cuts the wick correctly. You can now light it.




4. Always keep the trimmer in a safe place.

If you do not have a trimmer, burn the top of the wick.

1. Turn the wick down until 2 mm (1/10th of an inch) shows.




2. Light the wick. Wait until it burns out.
3. Blow the ashes off. They must not fall into the burner.
4. The wick is now level.

## How to change the wick

Change your wick when you cannot turn it up any more to trim it. Always clean the burner before you change the wick.

Make sure that you have the correct size of wick. The size is usually on the side of the burner. Always keep at least two spare wicks in a store which you can lock.

Wrap the wicks in a plastic bag to protect them and always keep them dry.

The following directions describe how to change the wick of a small burner. Page 22 describes how to change the wick of a big burner.

## The small burner (8 or 10 inch wicks)

**1.** Turn the knob on the burner clockwise. This turns two gears inside the burner.

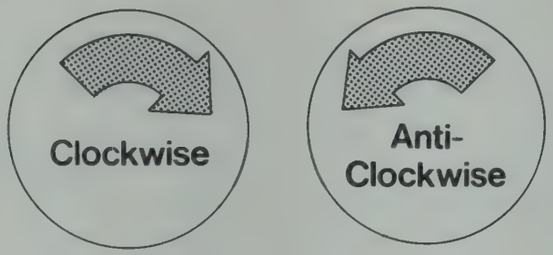
**2.** When the wick is free from the gears, pull it out from the burner.

**3.** Put the burner on its side on a flat surface. The knob must point upwards.

**4.** One end of the new wick is stiff and is usually red. Hold this end between your finger and thumb. Push both sides towards each other so that the end of the wick is curved.

**5.** Hold the burner on the flat surface with one hand. Gently push the curved end of the wick into the groove in the burner, until it will not go any further. Push the wick evenly on both sides. Otherwise the wick will stick in the burner.

**6.** Turn the knob clockwise until the end of the wick comes out at the top of the burner. If it is difficult to turn the knob clockwise, do not force it. It will break. Turn the knob anti-clockwise until the wick comes out at the bottom of the burner again. Start again.

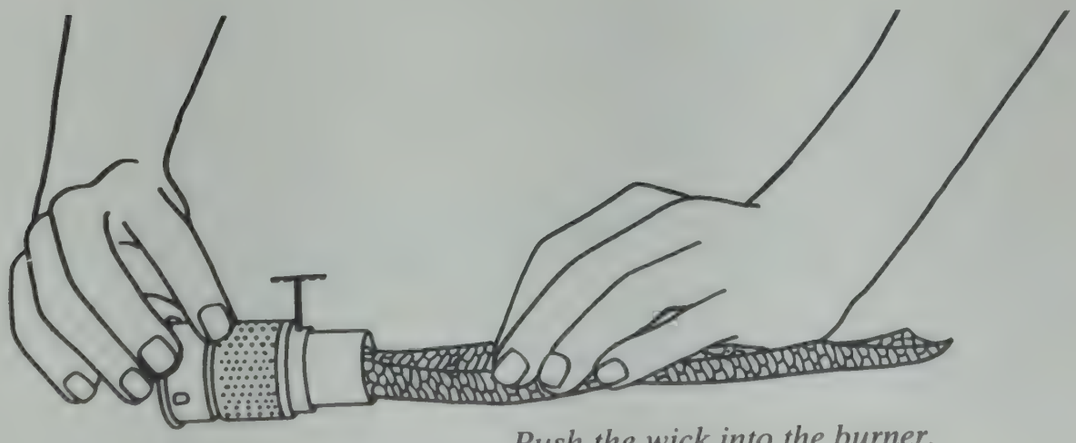



**7.** Raise the wick 2 cm (1 inch). The wick must be even at the top. If it is not even, pull the wick up gently at the top, until it is even.

**8.** Dip the top of the wick into clean kerosene. Put the burner back into the fuel tank, which should be full of clean kerosene.

**9.** You must allow the wick to take in the kerosene, otherwise you will destroy it. Wait one hour before you light the wick.

*Put the burner and wick on a flat surface.*



*Push the wick into the burner.*

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## The big burner (21 inch wicks)

**1.** Take the crown off the burner.

**2.** Take out the diffuser.

**3.** On the wick is a metal ladder which fits onto a gear inside the burner. When you turn the knob, the gear also turns. Turn the knob clockwise until the metal ladder moves up and comes away from the gear.

**4.** When the metal ladder is free from the gear, take the wick out of the burner.

**5.** Two metal clips hold the metal ladder on the wick. Remove the metal ladder from the clips.

**6.** On the end of the new wick there are bits of paper, which are called tails. Put the ends with the tails into the top of the burner.

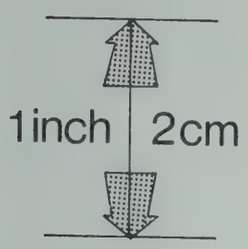
**7.** Fit the metal ladder into the metal clips on the new wick. The ladder must fit on the same side as the gear and must point down to the tails of the wick.

**8.** Pull the tails gently until the ladder moves down onto the gear again. When you turn the knob anti-clockwise the wick moves down.

**9.** Pull the paper tails off the wick.

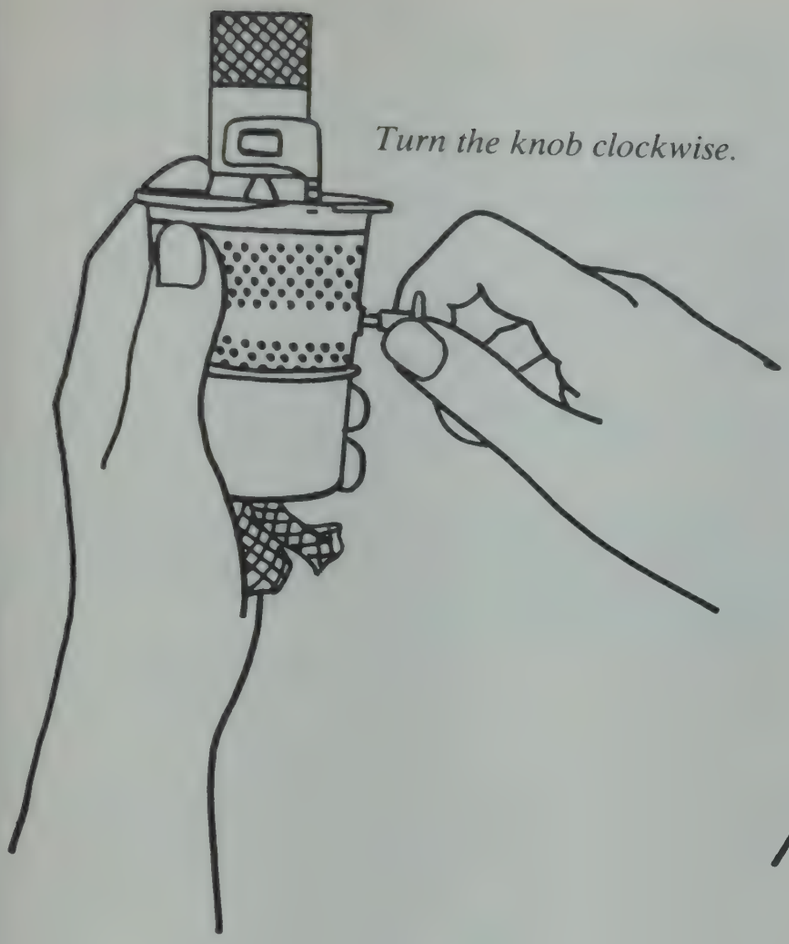
**10.** Put the diffuser inside the wick and the crown on top of the burner.

**11.** Turn the wick up 2 cm (1 inch). Dip the top of the wick into clean kerosene. Put the burner back into the fuel tank, which should be full of clean kerosene.

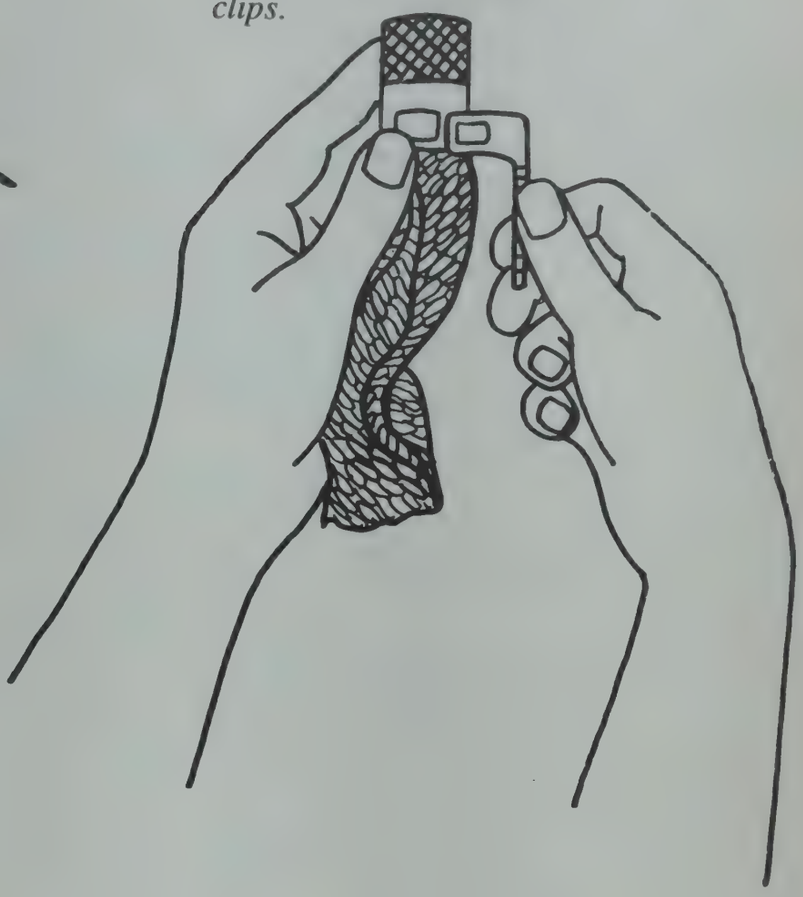



**12.** You must allow the wick to take in the kerosene, otherwise you will destroy it. Wait for one hour before you light the wick.

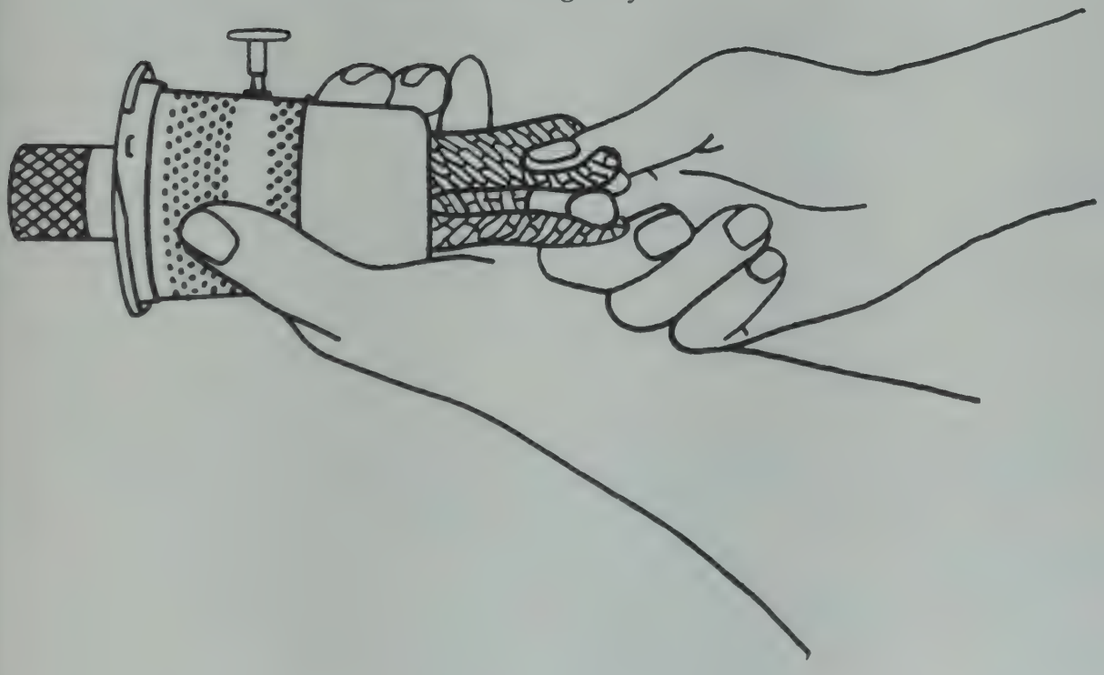
*Turn the knob clockwise.*



*Remove the metal ladder from the clips.*

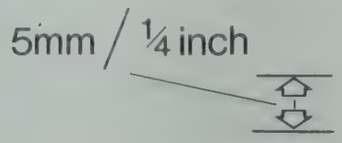


*Pull the tails gently.*



## How to light the burner

1. When you put the new wick in the burner, wait one hour. Then light the wick.
On the Electrolux RAK 66 or RAK 100 connect the control knob to the burner again. Pull the control knob towards you. Then let it go so that the rod fits into the holes on the burner knob.
2. Gently turn the wick up until 5 mm (¼ inch) shows.




3. Light the wick. Wait for the flame to spread round the whole wick. (On the Electrolux RAK 100 and RC 65 you must remove the crown to light the wick. Then replace it again.)
4. Gently replace the lamp glass on the burner. Turn the lamp glass a little and push it down very gently into the burner. Be careful as the lamp glass is very delicate.
5. Put the lamp glass insert on top of the lamp glass.
6. Gently slide the tank back under the main storage cabinet until the burner fits exactly under the flue.
7. If smoke comes from the flame, turn the wick down a little.
8. On big refrigerators, like the Electrolux RAK 100 or RC 65, the flame should be blue. On small refrigerators, like the Electrolux RAK 66 or RAK 36 the flame should be yellow. Check that the flame is the correct colour.
9. Check the flame again after ten minutes. If smoke comes from the flame, turn down the wick. Check again that the flame is the correct colour.
10. It takes at least one day for the refrigerator to get cold when you light it for the first time. The correct temperature inside the refrigerator is 4°C–8°C.

## How to control the temperature

A big flame produces more heat which pushes the refrigerant through the pipes faster. This makes the refrigerator colder. You turn the knob on the burner clockwise to make the flame bigger.

*A large flame produces a low temperature.*

A small flame produces less heat and so the inside of the refrigerator is warmer. You turn the knob on the burner anti-clockwise to make the flame smaller.

*A small flame produces a high temperature.*

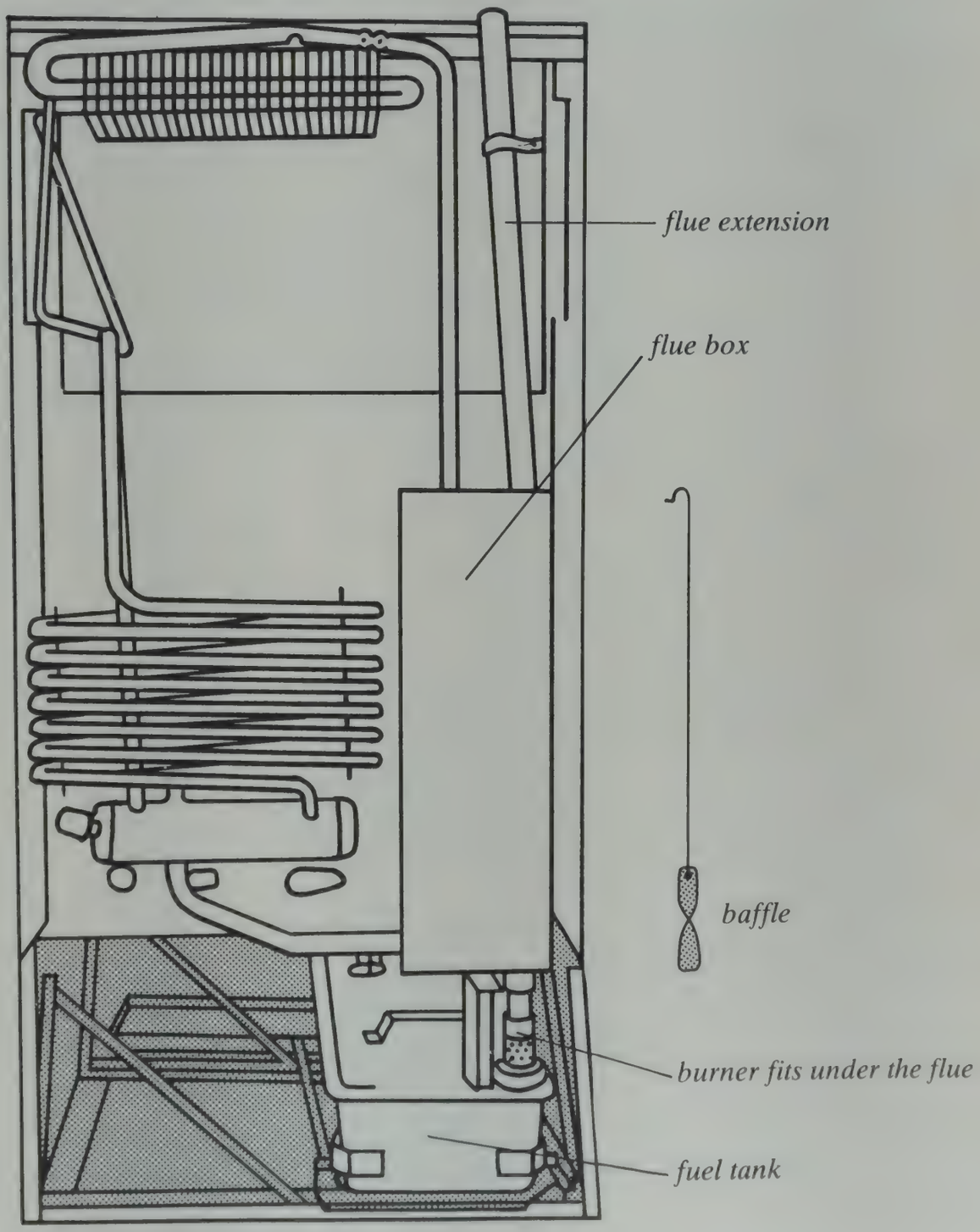
Always keep a thermometer in the main storage cabinet.

# The flue and baffle

The flue is a long metal tube at the back of the refrigerator. It is above the burner and lamp glass so that the heat from the flame can rise up the flue. The refrigerator will only work if the burner and lamp glass fit exactly under the flue.

The baffle is a piece of twisted metal on the end of a long wire. It hangs in the flue just above the burner. The baffle is very important, because it helps the heat to rise up the flue. If there is no baffle, your refrigerator will not work.

Always keep the flue and baffle clean.



## How to clean the flue and baffle

*special brush*

Clean the flue and baffle at least once a week.

There is a special brush for cleaning the flue. Lock it in your store.

**1.** Pull the tank and burner from under the flue.

**2.** Put paper on the floor under the flue to catch the dirt.

**3.** Pull the wire with the baffle out of the top of the flue.

**4.** Put the brush down the flue and move it up and down several times. Turn the brush around, so that it scrapes the dirt off the sides of the flue. Do this until dirt stops falling on the paper.

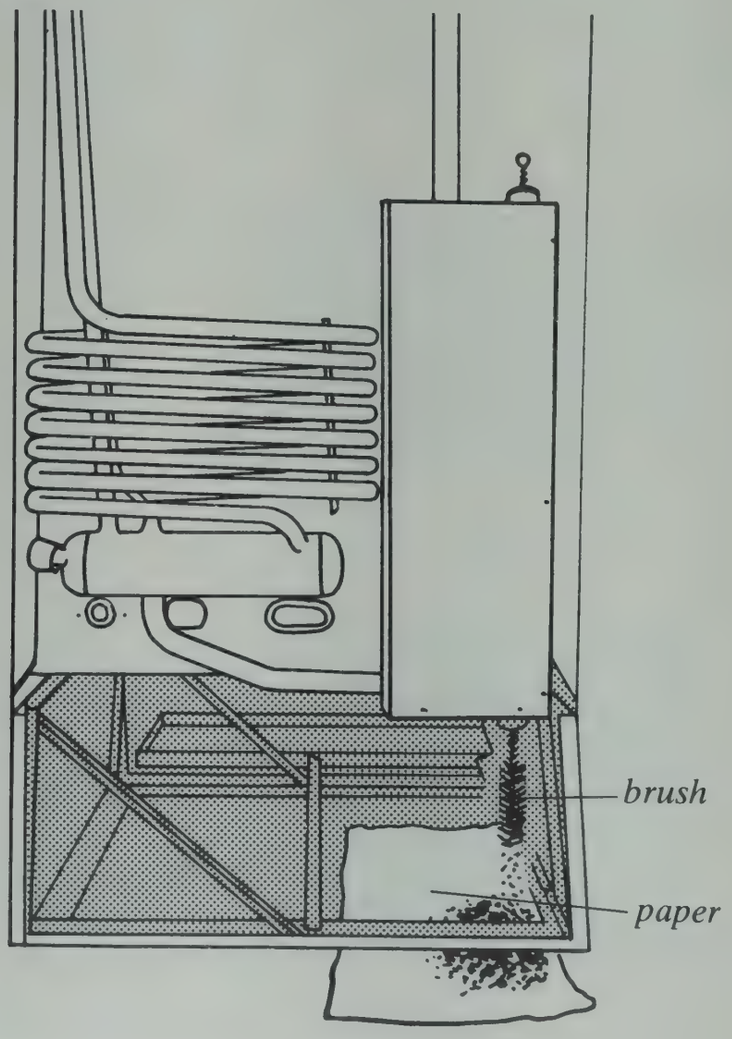
**5.** Remove the paper with the dirt from under the flue.

**6.** Wipe the baffle with a clean cloth and clean kerosene.

**7.** Put the wire with the baffle back into the flue. The wire is the right length for the flue. Do not change or bend this wire.

**8.** If everything is clean, light the wick and put the fuel tank under the storage cabinet.

**9.** Wash and dry the brush. Lock it in your store.



# Electric (absorption) refrigerators

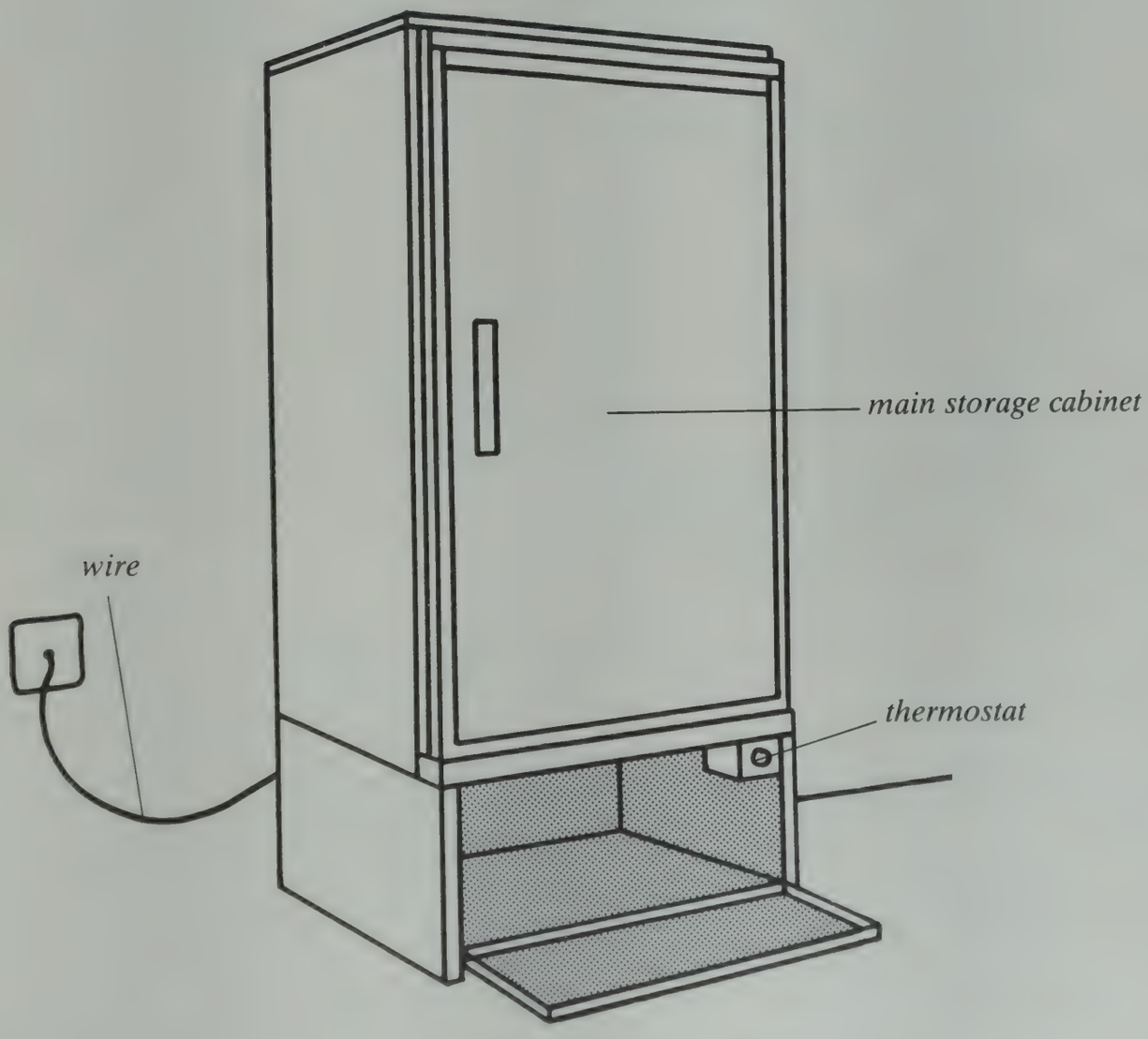
Under the main storage cabinet of every electric (absorption) refrigerator is an electric element and a thermostat. This electric element is the heating unit. Above the electric element at the back of the refrigerator is a long metal tube. This is the flue.

The electric element is a piece of metal wire. When electricity passes through the element, it becomes hot. The heat pushes the refrigerant through the pipes at the back of the refrigerator and the inside of the refrigerator becomes cold.

The thermostat is a dial with numbers. It controls the amount of heat which the electric element produces.

On electric refrigerators a wire with a plug on the end leads out from the electric element. The plug fits into a socket on the wall. When you turn the electricity on at the socket, it passes through the wire to the electric element. If the electricity supply is irregular you need a voltage stabiliser.

Always keep your refrigerator clean.



# The electric element

The electric element does not produce smoke and dirt like the kerosene burner. But you must look after it. The electric element must have a continual supply of electricity. Every day you must check the following things.

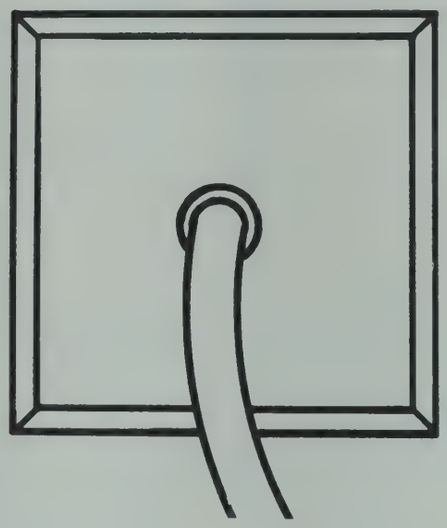
**1.** Check that all electrical connections work properly, especially the plug. Ask a technician to help you, if you do not know how to wire a plug.

**2.** Check that the plug fits in the socket properly. Tape the plug to the socket, so that it does not come out by mistake.

**3.** Check that the electricity switch is on. Tape the switch into the 'on' position. Then you cannot turn if off by mistake. In some clinics the wire of the electric element leads directly into the wall. This stops you turning the refrigerator off by mistake.

**4.** Use a voltage stabiliser if the electricity supply changes. If the electric light in the room where you keep the refrigerator is brighter than usual, too much electricity is passing through the electric element. The electric element becomes so hot that it breaks. Then the refrigerator stops working. If the light is not as bright as usual, too little electricity is passing through the electric element. Then the inside of the refrigerator becomes warm. A voltage stabiliser allows the right amount of electricity to pass into the electric element. The wire from the electric element leads to the voltage stabiliser. Then another wire leads from the voltage stabiliser to the socket in the wall.

**5.** Always keep spare fuses or spare fuse wires. Learn how to wire a plug and repair a fuse.



# The thermostat

The thermostat is a dial. It controls the temperature inside the refrigerator. On some refrigerators the dial has numbers. And on other refrigerators it has the words **Maximum** and **Minimum** on it.

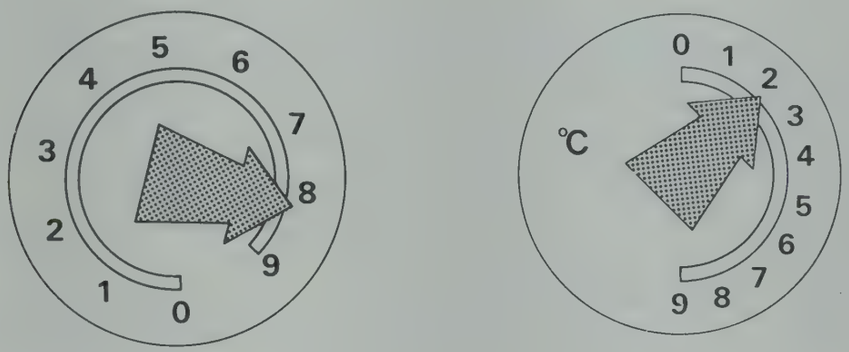
When you want the refrigerator colder inside, turn the dial to a big number or **Maximum.** When you want the inside of your refrigerator warmer, turn the dial to a small number, or **Minimum.**

It takes one day for the temperature inside the refrigerator to change. Always check the temperature again the next day.

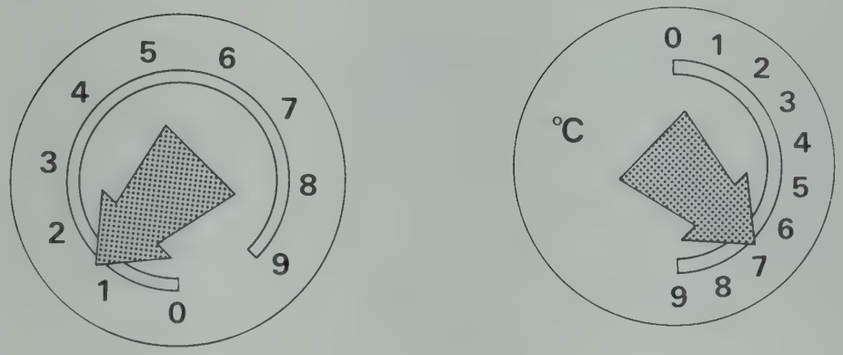
Always keep a thermometer in the main storage cabinet.

The correct temperature for storing vaccines in the main storage cabinet is 4°C–8°C.

*A big number, or maximum, produces a low temperature.*




*A small number, or minimum, produces a high temperature.*




# The flue

The flue is a long metal tube at the back of the refrigerator. It is exactly above the electric element. The heat from the electric element rises up the flue. As there is no smoke this flue does not become dirty.

The electric (absorption) refrigerator does not have a baffle.

# Gas (absorption) refrigerators

Under the main storage cabinet of every gas refrigerator is a gas burner. This burner is the heating unit. It has a very small tube, through which the gas passes. This tube is called the jet. The gas burner produces the heat, which pushes the refrigerant through the pipes at the back of the refrigerator. This makes the inside of the refrigerator cold. The burner is very delicate. Never touch it.

Above the burner at the back of the refrigerator is a long metal tube, which is called the flue. Inside the flue is the baffle. The baffle is a piece of twisted metal on the end of a long wire. It helps hot air rise up the flue.

Next to the gas refrigerator is a gas cylinder. The cylinder must always be upright and level. Inside the cylinder is a liquid, which is called Liquid Propane Gas. When this liquid leaves the cylinder through the valve on the top, it turns into a gas. The gas passes through a pressure regulator, which is connected to the valve. A gas pipe connects the cylinder to the burner.

The pressure regulator controls the amount of gas which is flowing through the gas pipe to the burner.

Below the door of the refrigerator there are usually three buttons.

## The thermostat

The thermostat controls the temperature inside the refrigerator.

## The lighting button

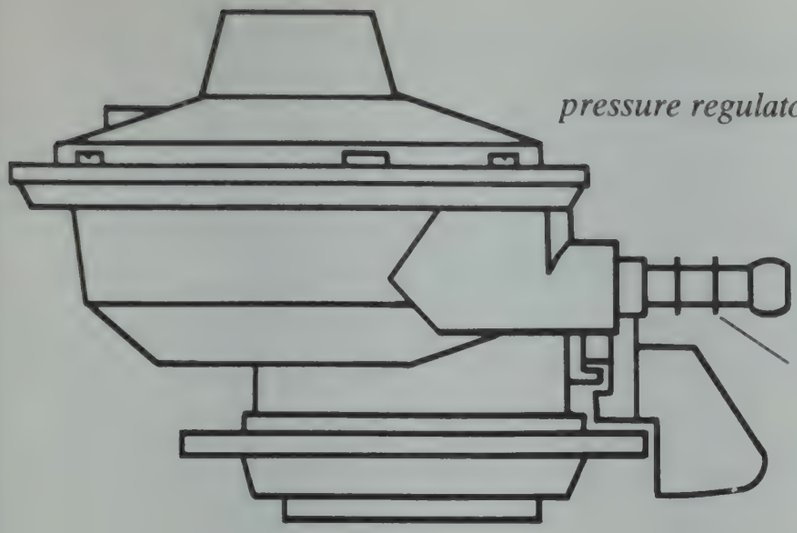
When you press the lighting button you light the gas in the burner. Some refrigerators do not have a lighting button so you must light them with a match.

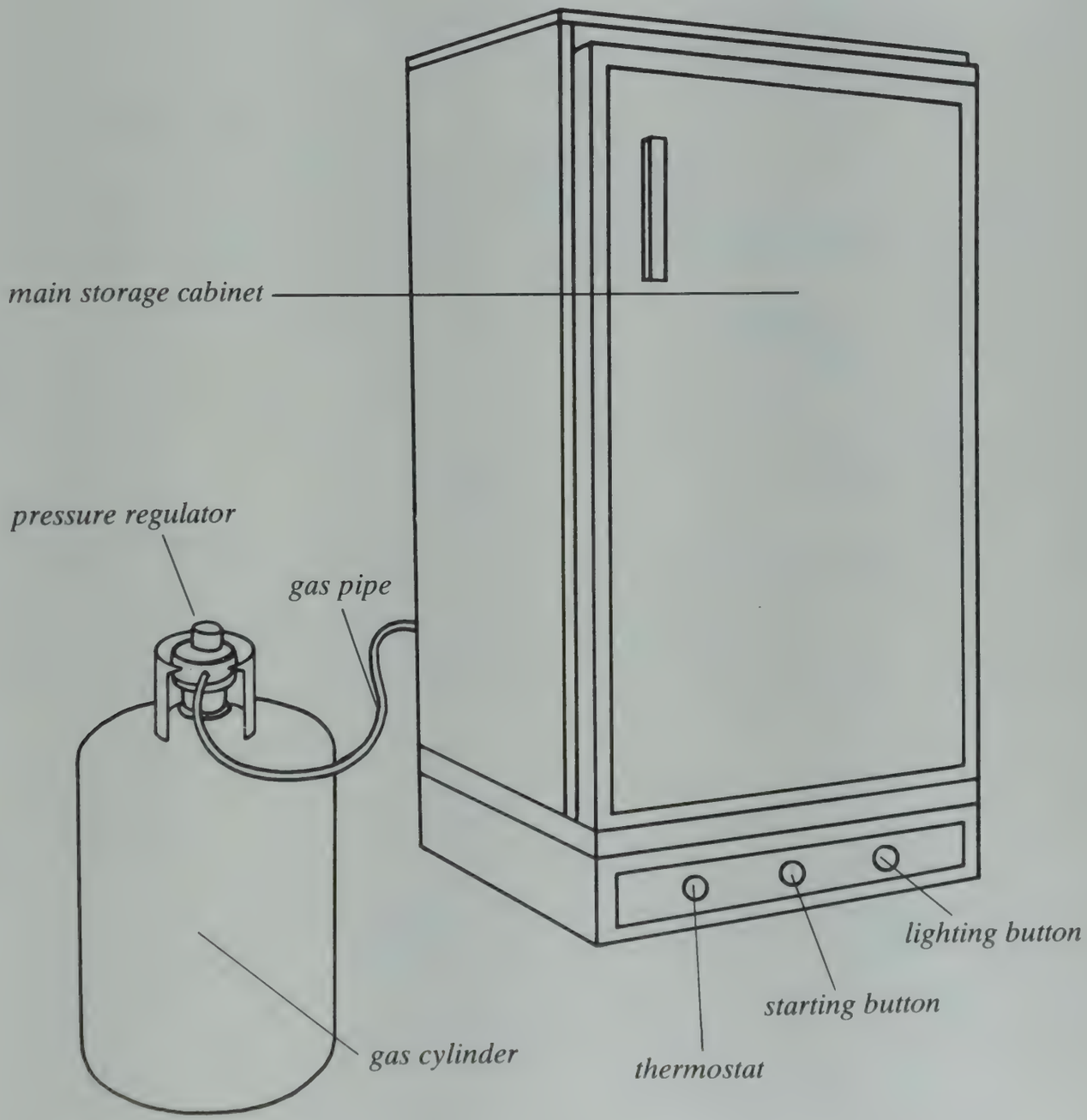
## The starting button

If the flame in the burner goes out by accident the burner becomes cold. A special part in the refrigerator then stops the supply of gas. When you press the starting button the gas flows through the cold burner.

There is also a mirror under the door. You can see the flame of the gas burner in this mirror.

Always keep a spare gas cylinder in a store which you can lock. Keep the key at the clinic.


pressure regulator
Gas pipe fits here.


main storage cabinet
pressure regulator
gas pipe
gas cylinder
lighting button
starting button
thermostat

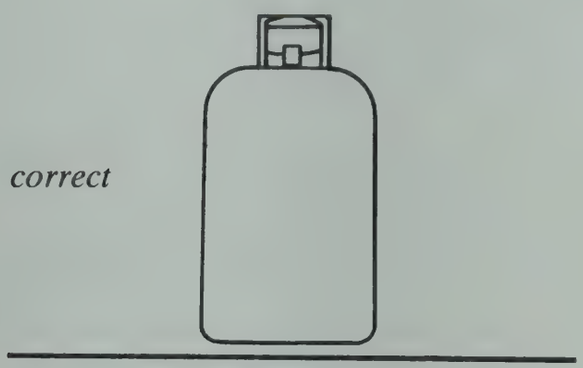
# How to connect the gas cylinder to the refrigerator

Never smoke when you connect the gas cylinder to the refrigerator. Make sure that there are no flames near you. The gas may light and explode.

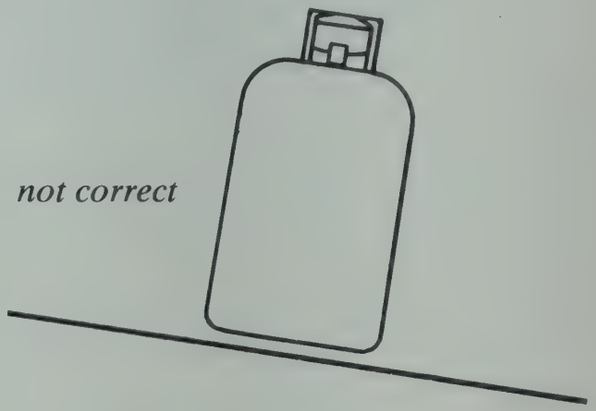
**1.** Remember to check that the gas cylinder is level and upright.

**2.** Put the thread of the pressure regulator into the valve. Keep the valve and thread straight.

*correct*



*not correct*



**3.** Turn the screw on the pressure regulator anti-clockwise until the thread is tight in the valve.

**4.** Connect one end of the rubber gas pipe to the pressure regulator. Connect the other end to the refrigerator.

**5.** The gas pipe must fit onto the regulator and the refrigerator properly. It must hang loose and not stretch tight. If the gas pipe is twisted gas will not pass through it. Keep the gas cylinder and the gas pipe in a place where you will not fall over them.

**6.** Before you open the valve on the gas cylinder you must check for gas leaks.

**How to check for gas leaks**

Make a solution of soap and water. With a clean cloth put this solution on all connections. Open the valve on top of the gas cylinder. If you see bubbles on any of the connections, there is a leak. You must then tighten the connection. If there is a leak in the gas pipe, you must repair it or use a new one.

If there are no bubbles you can keep the valve open and light the burner.

Never smoke while you are checking for leaks. Keep all flames away.

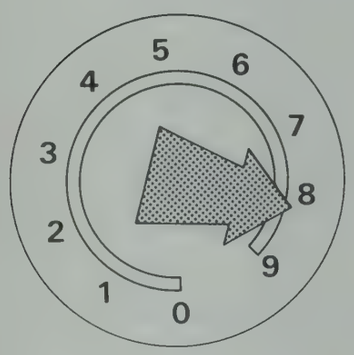
Always keep at least one spare gas pipe.

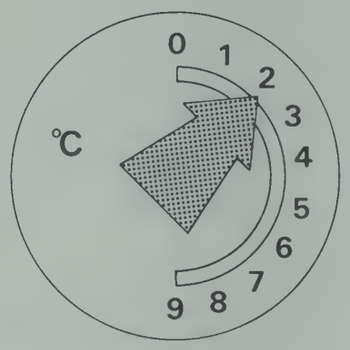
# The thermostat

The thermostat is a dial. It controls the temperature inside the refrigerator. On some refrigerators the dial has numbers, and on other refrigerators it has the words **Maximum** and **Minimum** on it. When you want the inside of the refrigerator colder, turn the dial to a big number, or **Maximum**. When you want the inside of your refrigerator warmer, turn the dial to a small number, or **Minimum**.

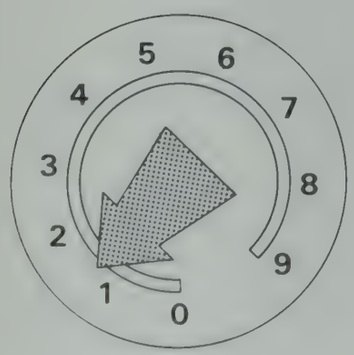
It takes one day for the temperature inside the refrigerator to change. Always check the temperature again the next day.

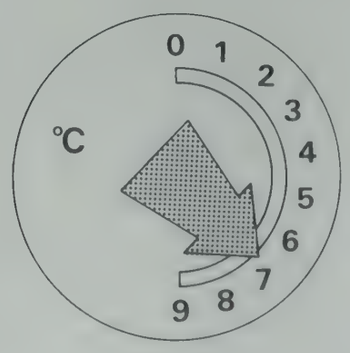
Always keep a thermometer in the main storage cabinet. The correct temperature for storing vaccines in the main storage cabinet is 4°C–8°C.




*A big number, or maximum, produces a low temperature.*




*A small number, or minimum, produces a high temperature.*

# How to light the burner

**1.** Remember to keep your refrigerator away from draughts.

**2.** Rock the gas cylinder gently to check that there is gas in it. You can hear the gas move inside.

**3.** Check that you have connected the gas pipe properly.

**4.** Open the valve on top of the cylinder.

**5.** Turn the thermostat to half way between the smallest number and the biggest number (or half way between **Minimum** and **Maximum**).

**6.** Press the starting button and continue to press for half a minute. On some refrigerators you must press the starting button and then turn it anti-clockwise. If you are using a new gas cylinder press the button for two minutes. This pushes the air out of the gas pipe.

**7.** Now press the lighting button to light the gas and at the same time continue to press the starting button. Some refrigerators have a lighting button which you have to turn clockwise to light the gas. If your refrigerator does not have a lighting button use a match to light the gas.

**8.** You must press the starting button in for another 15 seconds after you light the gas. Otherwise the burner will be cold and the gas will stop. Let the starting button go after 15 seconds. Look at the burner and check that there is a flame.

**9.** If the flame goes out, start again. But press the starting button in for 30 seconds after you light the gas.

It takes one day for the temperature inside the refrigerator to change. Always check the temperature again the day after you light the burner.

The temperature in the main storage cabinet must be between 4°C and 8°C.

# How to clean the flue and baffle

The flue is the long metal tube at the back of the refrigerator, through which the heat from the gas burner rises. Inside the flue is the baffle. It is a piece of twisted metal on the end of a long metal wire. If the baffle is not inside the flue, the refrigerator cannot work properly. The flue and the baffle are very important. You must keep them clean.

When gas burns it produces very little dirt. You must still clean the flue and baffle regularly.

There is a special brush for cleaning the flue. Always keep it in a store which you can lock.

**1.** Close the valve on the gas cylinder to turn off the gas.

**2.** Cover the gas burner with a piece of clean cloth to collect the dirt and protect the burner. Do not damage the burner.

**3.** Take the baffle out of the flue.

**4.** Put the brush down the flue and move it up and down several times. Turn the brush round, so that it scrapes the dirt off the sides of the flue. Do this until dirt stops falling on the cloth.

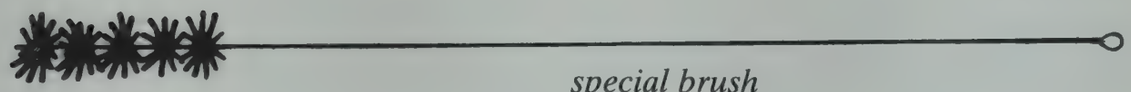
**5.** Carefully remove the cloth with the dirt from under the flue. You must not spill the dirt on the burner.

**6.** Wipe the baffle with a clean cloth.

**7.** Put the wire with the baffle back into the flue. The wire is the right length for the flue. Do not change or bend the wire.

**8.** Now light the burner.

**9.** Wash and dry the special brush. Lock it in your store.



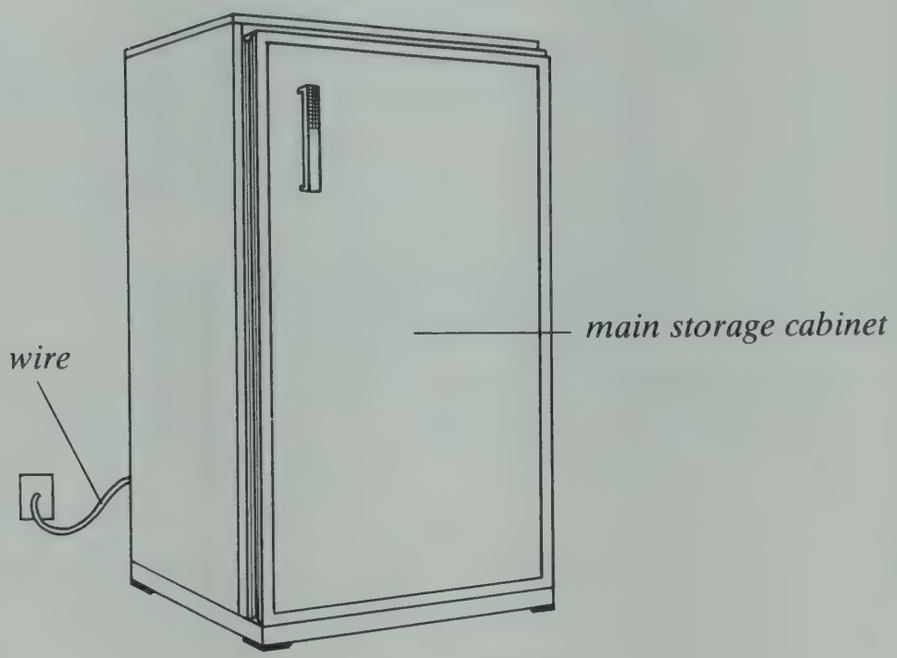
*special brush*

# Electric (compression) refrigerators

Every electric (compression) refrigerator has a compressor which is an electric motor. The compressor pushes the refrigerant through the pipes at the back of the refrigerator. This keeps the inside of the refrigerator cold. A compressor needs a continual supply of electricity.

Inside the main storage cabinet is a thermostat. The thermostat controls the temperature inside the refrigerator.

A wire with a plug on the end leads out from the compressor. The plug fits into a socket on the wall. When you turn the electricity on at the socket, it passes through the wire to the compressor.




# The compressor

A compressor is a very delicate electric motor. It does not become dirty. So you do not need to touch it. Only a skilled technician should repair it.

If the supply of electricity is not continuous, a compressor breaks down very quickly. It is difficult and expensive to repair a compressor. So you must make sure that the electric supply is continuous. If the supply is irregular, you need a voltage stabiliser.

You must look after the compressor. The following directions will help you.

**1.** Check that all electrical connections work properly, especially the plug. Ask a technician to help you, if you do not know how to wire a plug.

**2.** Check that the plug fits in the socket properly. Tape the plug to the socket so that it does not come out by mistake.

**3.** Check that the electricity switch is on. Tape the switch into the 'on' position. Then you cannot turn it off by mistake. In some clinics the wire from the compressor leads directly into the wall. This stops you turning the refrigerator off by mistake.

4. Use a voltage stabiliser if the electricity supply changes. If the electric light in the room where you keep the refrigerator is brighter than usual, too much electricity is passing through the compressor. The compressor becomes so hot that it breaks. Then the refrigerator stops working. If the light is not as bright as usual, too little electricity is passing through the compressor. Then the inside of the refrigerator becomes warm. A voltage stabiliser allows the right amount of electricity to pass into the compressor. The wire from the compressor leads to the stabiliser. Then another wire leads from the stabiliser to the socket on the wall.

5. Always keep spare fuses or spare fuse wires. Learn how to repair a fuse.

# The thermostat

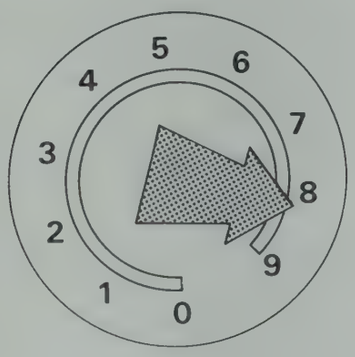
The thermostat is a dial. It controls the temperature inside the refrigerator. On some refrigerators the dial has numbers and on other refrigerators it has the words **Maximum** and **Minimum** on it.

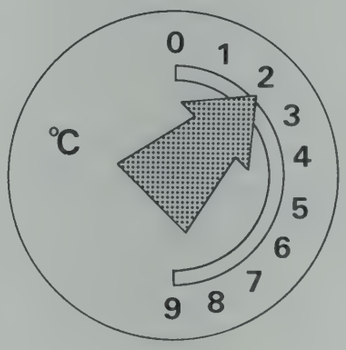
When you want the inside of the refrigerator colder, turn the dial to a big number, or **Maximum**.

When you want the inside of the refrigerator warmer, turn the dial to a small number, or **Minimum**.

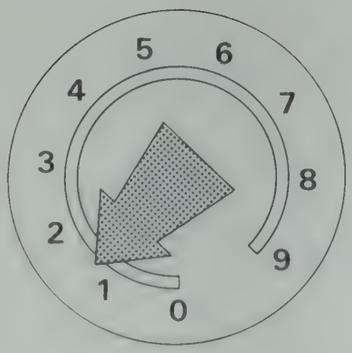
It takes one day for the temperature inside the refrigerator to change. Always check the temperature again the next day.

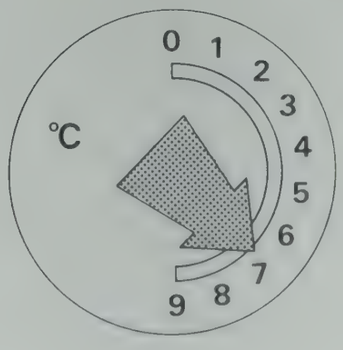
Always keep a thermometer in the main storage cabinet. The correct temperature for storing vaccines in the main storage cabinet is 4°C–8°C.




*A big number, or maximum, produces a low temperature.*




*A small number, or minimum, produces a high temperature.*

# Section 4

# Inside the refrigerator

## Where to keep the vaccines inside the refrigerator

**1.** Always keep DPT, tetanus toxoid and BCG vaccines in trays in the main storage cabinet of the refrigerator. The correct temperature here is between 4°C and 8°C.
You must never put DPT or tetanus toxoid vaccines in the freezing compartment. If you freeze them they lose their strength. Then they are useless. Keep the diluent in the main storage cabinet if there is room.

**2.** Always keep measles and polio vaccines in the freezing compartment. The temperature here must be below 0°C.

**3.** Never keep vaccines in the door of the refrigerator. The temperature in the door is above 8°C. The vaccines will lose their strength. They are then useless.

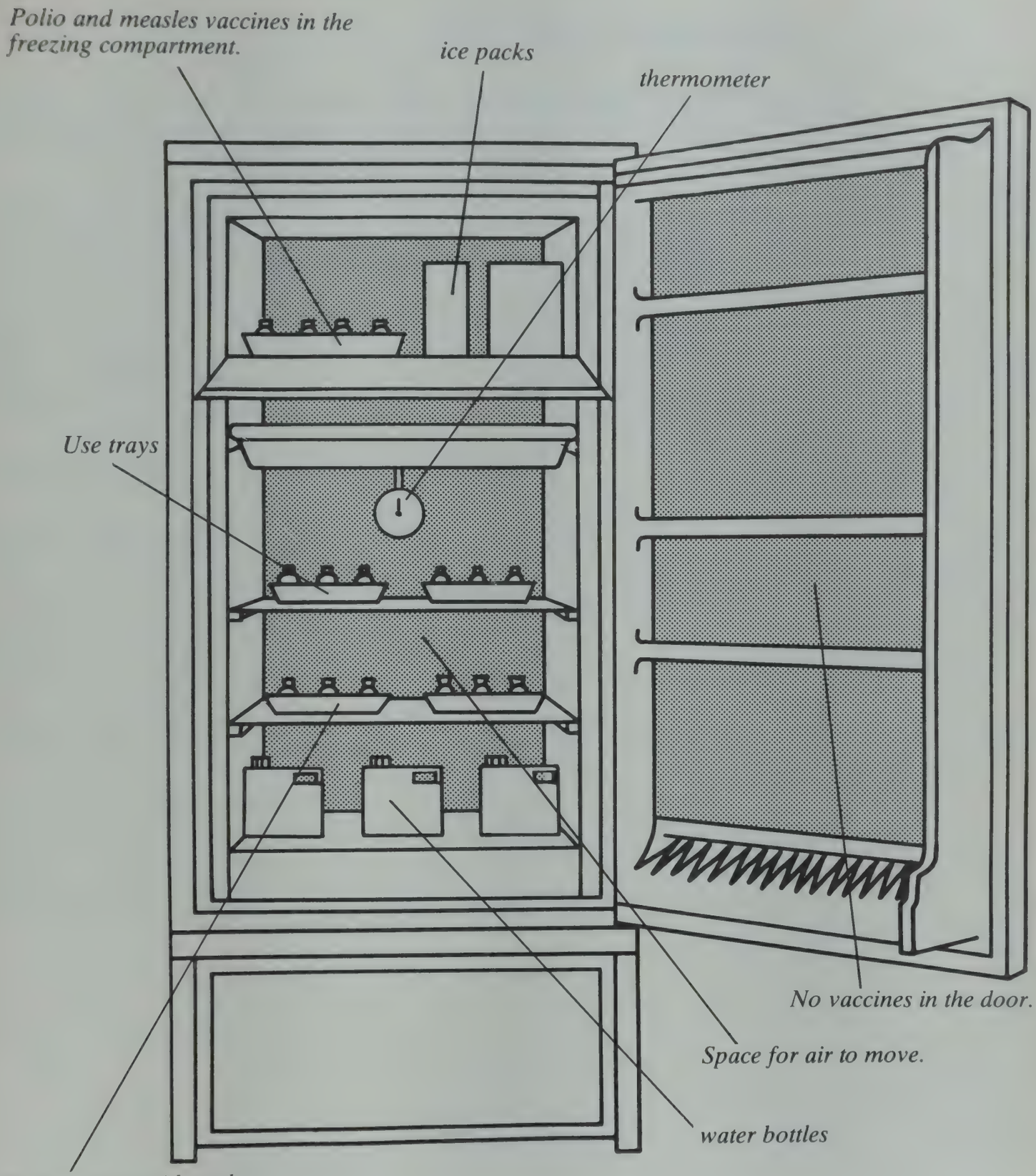
**4.** Always keep the same type of vaccine together in the trays. Each ampoule must carry the name of the vaccine.

**5.** You must use all the old vaccines before the new ones. Therefore keep old vaccines at the front of the refrigerator and new stocks at the back. Make sure that the old vaccine has not expired.

**6.** Store your vaccines neatly in wire trays. If you do not have wire trays, you can use cardboard boxes. Cut the tops off the cardboard boxes.

**7.** You must leave about 5 cm (2 inches) between the trays of vaccines. This allows the cold air to move around the refrigerator. If the cold air cannot move around the refrigerator becomes warm inside. This destroys the vaccines.

**8.** The vaccines must never touch the sides or back of the refrigerator. This is very important for DPT and tetanus toxoid vaccines, because you must never freeze them.


Polio and measles vaccines in the freezing compartment.
ice packs
thermometer
Use trays
No vaccines in the door.
Space for air to move.
water bottles
D.P.T., tetanus toxoid, and B.C.G. vaccines in the main storage cabinet.
Do not keep food in the refrigerator.

# How to keep the inside of the refrigerator cold

**1.** Fill all spare room in the freezing compartment with ice packs, ice trays or ice in plastic bags. If the refrigerator stops working, the ice will keep the vaccines cold.

**2.** Make sure all the ice packs touch the evaporator plate. The evaporator plate is the part in the freezing compartment where there is always ice. An ice pack will freeze quickly if you lay it flat on the evaporator plate. If you have a lot of ice packs stand them on their sides. Then they will all touch the evaporator place and freeze quickly.

**3.** Fill all spare room in the main storage cabinet with bottles of water. They help to keep the inside of the refrigerator cold when the door is open, and when the refrigerator breaks down. Never drink this water. If your refrigerator opens at the top put bottles of water or ice packs at the bottom. The ice packs must not freeze. This helps to keep the inside of the refrigerator at the correct temperature.

**4.** Leave about 5 cm (2 inches) between each ice pack or water bottle. This allows the cold air to move around.

**5.** Keep a thermometer in the middle shelf of the main storage cabinet. It is easy to read if you keep it at the front of the shelf. Some refrigerators have a thermometer on the door. Check the temperature twice a day.

**6.** Lock your refrigerator if possible. Always keep the key at the clinic.

**7.** Open the door of the refrigerator only when it is necessary. Each time you open the door cold air escapes and hot air gets in. The temperature in the refrigerator rises. It takes the temperature two hours to fall again.

**8.** Never put food or drink in the refrigerator. People will open the door continually to take out food. The refrigerator will become warm and the vaccines will lose their strength.

**9.** There must be no gap between the door and the refrigerator when the door is closed. A gap allows hot air into the refrigerator and the temperature inside rises. To check for gaps put a piece of paper between the door and the refrigerator. If the paper goes in easily there is a gap. Check all the way round the door. You can fill the gaps with tape. Stick the tape onto the refrigerator.

# Section 5

# How to look after your refrigerator

## How to look after your refrigerator each day

One person must be responsible for looking after the refrigerator every day. If the person is sick or goes on holiday, another person must look after it.

Every day there are some things you must check.

**1.** Check the temperature in the refrigerator every morning when you come to work. Check it again before you leave in the evening.

**2.** Record the temperature on a form like the one on page 58. Keep it near the refrigerator. The temperature in the main storage cabinet must be between 4°C and 8°C. If it is not, you must change it. Check the temperature the next day, as it takes one day for it to change.

**3.** Open the door of the refrigerator only when you take out or put in vaccines. Before you leave at night check that the door is closed. Lock it, if you can.

**4.** Check that there are ice packs in the freezing compartment and bottles of water in the main storage cabinet. The ice packs must always be frozen hard. There must be room for the cold air to move around the inside of the refrigerator.

**5.** Check that you have enough vaccine.

**6.** Never keep food or drink in the refrigerator.

**7.** Never keep vaccines in the door of the refrigerator.

**8.** If you have a kerosene refrigerator fill the fuel tank every day with clean kerosene. If you leave the clinic make sure that there is always kerosene in the fuel tank. Check that the flame is the correct colour. If it produces smoke, turn the flame down a little. If it still produces smoke, clean the burner, the flue and the baffle. Trim the wick. Only use clean kerosene.

**9.** If you have an electric refrigerator, check that you have taped the plug in the socket. Check also that you have taped the switch in the 'on' position.

**10.** If you have a gas refrigerator, check that there is gas in the gas cylinder. Check that you have connected the cylinder to the refrigerator properly. Also make sure that there are no leaks. If you leave the clinic for several days make sure that there is enough gas in the cylinder. The refrigerator must work while you are away. Continually check that there is a flame.

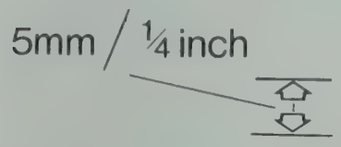
# How to look after your refrigerator each week

One day each week you must do the following things.

**1.** Clean the condenser coils at the back of the refrigerator with a brush. If the coils are dirty, the refrigerator does not work properly. Be careful as the coils are hot.

**2.** If you have a kerosene refrigerator clean the flue, the baffle, the burner and trim the wick.

**3.** Defrost your refrigerator when the ice on the freezing compartment walls becomes more than 5 mm (¼ inch) thick. Otherwise your refrigerator will not work properly. Some modern gas and electric refrigerators defrost themselves so you do not have to do it.




## How to defrost your refrigerator

**1.** First you need another refrigerator or a cold box to keep your vaccines in. Freeze ice packs before you defrost the refrigerator and put them in the cold box. Put the vaccines in the refrigerator or cold box carefully. You must not freeze DPT or tetanus toxoid vaccines. (Read the section on cold boxes). Open the cold box only when you want to take out or put in vaccines. Each time you open the cold box, the temperature rises. Keep the cold box in a cold place.

**2.** Turn off your refrigerator.

**3.** Put one bowl of hot water in the freezing compartment and one bowl in the main storage cabinet.

**4.** With a clean cloth and hot water you can wipe the ice to help it melt.

**5.** Leave the door of the refrigerator open.

**6.** When all the ice melts, wipe the inside walls with a clean cloth and water. Also clean the shelves.

**7.** Dry the inside walls and shelves with a clean cloth.

**8.** If you have a kerosene refrigerator clean the burner, the flue and the baffle, while you wait for the ice to melt.

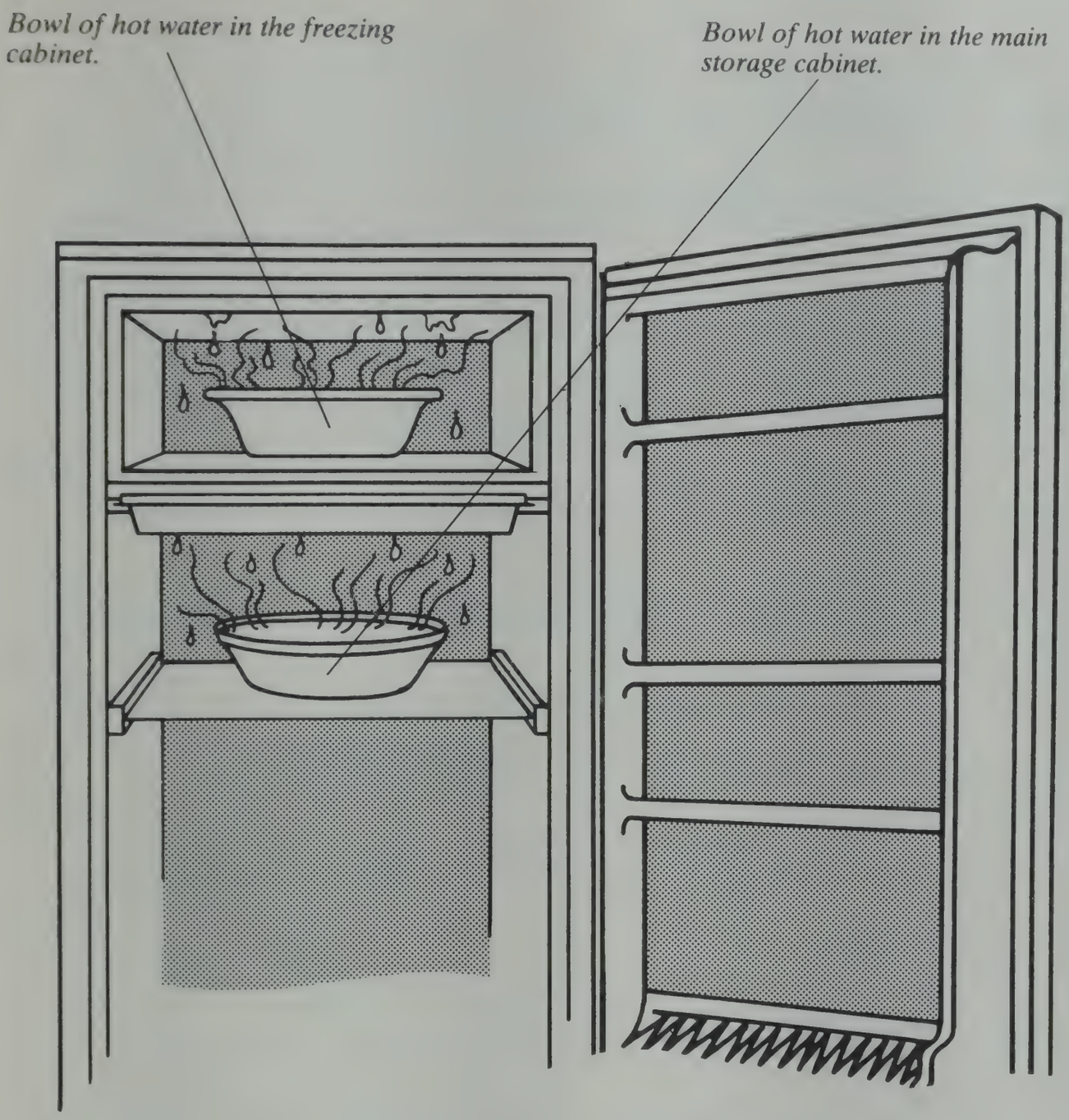
**9.** Close the door of the refrigerator.

**10.** Turn the refrigerator on again.

**11.** Wait until the temperature in the refrigerator is between 4°C–8°C. It usually takes one day for the refrigerator to reach the correct temperature.

**12.** Now put the vaccines in the refrigerator carefully.

If you turn the refrigerator off and do not use it, leave the door open.


*Bowl of hot water in the freezing cabinet.*
*Bowl of hot water in the main storage cabinet.*

# Section 6

# What to do in an emergency

If you look after your refrigerator, you will have no problems. Sometimes things can go wrong.

If the temperature in the main storage cabinet is below 4°C change the thermostat or flame to produce a higher temperature.

If the temperature in the main storage cabinet is above 8°C, check all the items in one of the following parts, which describes your refrigerator.

## Kerosene (absorption) refrigerators

Check every item on this list and take the necessary action.

| | Question | Answer | What you should do |
|---|---|---|---|
| **Fuel** | | | |
| **1.** | Is there kerosene in the tank? | NO | Fill the tank. Filter the kerosene. Relight the burner. |
| **Flame** | | | |
| **2.** | Is the flame too small? | YES | Turn the flame up but check for smoke. |
| **3.** | Is the flame the right colour? | NO | Raise or lower the wick. |
| **4.** | Is the flame even? | NO | Trim the wick. Replace the wick if you need a new one. |
| **5.** | Is the flame smoking? | YES | Turn down the flame. If the lamp glass is broken fit a new one. If the flame still smokes clean the tank and the burner. |
| **6.** | Does the flame keep going out? | YES | There may be a draught. Find it. Stop it, or move the refrigerator. |

| | Question | Answer | What you should do |
|---|---|---|---|
| **Flue and baffle** | | | |
| **7.** | Does the lamp glass fit tightly under the flue? | NO | Move the tank until the lamp glass fits tightly. Fit a new lamp glass if it is broken. |
| **8.** | Is the flue clean? | NO | Clean the flue and baffle. |
| **9.** | Is the baffle in place? | NO | Find it. Hang it in the flue. |
| **Other things** | | | |
| **10.** | Does the refrigerator door close tightly? | NO | If there is a gap between the door and the refrigerator, repair it. |
| **11.** | Is there lots of ice on the freezing compartment walls? | YES | Defrost the refrigerator. |
| **12.** | Are the vaccines too close together? | YES | Store the vaccines correctly, with room between them. |
| **13.** | Is the refrigerator level, away from the wall, out of direct sunlight? | NO | Use a plumb line to level the refrigerator. Move it out of the sunlight and away from the wall. |
| **14.** | Are there too many unfrozen ice packs in the freezing compartment? | YES | Take some out. |

Check the temperature the next day. It should fall to between 4°C and 8°C. If it doesn't, turn the flame a little higher. Wait overnight again. Check again.

If the temperature still rises put the vaccines in another refrigerator, or in a cold box. Ask a technician for help.

## Spares

Always keep in stock

1. Extra kerosene (at least one spare can).
2. One funnel.
3. One filter cloth.
4. Two wicks of the right size.
5. Two wick trimmers.
6. Four lamp glasses of the right size.
7. One spare burner of the right size.
8. One flue brush.

# Electric (absorption) refrigerators

Check every item on this list and take the necessary action.

| | Question | Answer | What you should do |
|---|---|---|---|
| **Electricity** | | | |
| **1.** | Have you plugged the refrigerator in? | NO | Plug it in. Tape the plug to the socket. |
| **2.** | Is the electricity on? | NO | Switch it on. Tape the switch in the 'on' position. |
| **3.** | Are the connections in the plug good? | NO | Reconnect the wires in the plug. Ask a technician to show you how to do this. |
| **4.** | Is the socket faulty? | YES | Try the plug in another socket. |
| **5.** | Has a fuse in the power supply blown? | YES | Replace the fuse. Ask a technician to show you how to do this. |
| **6.** | Is the main supply of to the building working? | NO | Tell the electricity company immediately. Find a gas or kerosene refrigerator for the vaccines. (Some electric refrigerators also have a kerosene burner, for an emergency.) Or put the vaccines in a cold box with ice. |
| **7.** | Is the electric element broken? | YES | Fit a new element. |
| **Other things** | | | |
| **8.** | Is the thermostat at a small number (or **Minimum**)? | YES | Turn the thermostat to a big number (or **Maximum**). |
| **9.** | Does the door of the refrigerator close? | NO | If there is a gap between the door and the refrigerator repair it. |
| **10.** | Is there lots of ice on the freezing compartment walls? | YES | Defrost the refrigerator. |
| **11.** | Are the vaccines too close together? | YES | Store the vaccines correctly with room between them. |
| **12.** | Is the refrigerator level, away from the wall, out of direct sunlight? | NO | Use a plumb line to level it. Move it away from the wall and move out of sunlight. |
| **13.** | Are there too many unfrozen ice packs in the refrigerator? | YES | Take some out. |

Check the temperature the next day. It should fall to between 4°C and 8°C.

If the temperature still rises put the vaccines in another refrigerator, or in a cold box. Ask a technician for help.

## Spares

Always keep in stock

1. Spare fuses or fuse wire.
2. One electric element.
3. A small screwdriver to change the element.

# Gas (absorption) refrigerators

Check every item on this list and take the necessary action.

| | Question | Answer | What you should do |
|---|---|---|---|
| **Gas supply** | | | |
| **1.** | Is there gas in the cylinder? | NO | Change the gas cylinder. Order a new one. |
| **2.** | Are there any gas leaks? | YES | Tighten the connections. Fit a new gas pipe if necessary. |
| **3.** | Have you turned the gas tap on the cylinder on? | NO | Turn it on fully. |
| **The burner** | | | |
| **4.** | Is there a flame? | NO | Light the burner. |
| **5.** | Does the flame keep going out? | YES | Look for a draught. Find it. Stop it or move the refrigerator. |
| **Flue and baffle** | | | |
| **6.** | Is the baffle in place? | NO | Find it. Hang it in the flue. |
| **7.** | Is the flue clean? | NO | Clean the flue and baffle. |
| **Other things** | | | |
| **8.** | Is the thermostat at a small number (or **Minimum**)? | YES | Turn the thermostat to a big number (or **Maximum**). |
| **9.** | Does the door close tightly? | NO | If there is a gap between the door and the refrigerator, repair it. |
| **10.** | Is there lots of ice on the freezing compartment walls? | YES | Defrost the refrigerator. |
| **11.** | Are the vaccines too close together? | YES | Store the vaccines correctly with room between them. |
| **12.** | Is the refrigerator level, away from the wall, out of direct sunlight? | NO | Use a plumb line to level it. Move it away from the wall and out of the sunlight. |
| **13.** | Are there too many unfrozen ice packs in the freezing compartment? | YES | Take some out. |

Check the temperature the next day. It should fall to between 4°C and 8°C.

If the temperature still rises, put the vaccines in another refrigerator, or in a cold box. Ask a technician for help.

## Spares

Always keep in stock

1. One spare gas cylinder.
2. One spare gas pipe.

# Electric (compression) refrigerators

Check every item on this list and take the necessary action.

| | Question | Answer | What you should do |
|---|---|---|---|
| **Electricity** | | | |
| **1.** | Have you plugged the refrigerator in? | NO | Plug it in. Tape the plug to the socket. |
| **2.** | Is the electricity on? | NO | Switch it on. Tape the switch in the 'on' position. |
| **3.** | Are the connections in the plug good? | NO | Reconnect the wires in the plug. (Do you know how to do this?) |
| **4.** | Is the socket faulty? | YES | Try the plug in another socket. |
| **5.** | Has a fuse in the power supply blown? | YES | Replace the fuse. Ask a technician to show you how to do this. |
| **6.** | Is the main supply of electricity to the building working? | NO | Call the electricity company immediately. Find another kerosene or gas refrigerator for the vaccines. Or put the vaccines in a cold box with ice. |
| **Other things** | | | |
| **7.** | Is the thermostat at a small number (or **Minimum**)? | YES | Turn the thermostat to a high number (or **Maximum**). |
| **8.** | Does the door of the refrigerator close properly? | NO | If there is a gap between the door and the refrigerator, repair it. |
| **9.** | Is there lots of ice on the freezing compartment walls? | YES | Defrost the refrigerator. |
| **10.** | Are the vaccines too close together? | YES | Store the vaccines correctly with room between them. |
| **11.** | Is the refrigerator level, away from the wall, out of direct sunlight? | NO | Use a plumb line to level it. Move it away from the wall and out of the sunlight. |
| **12.** | Are there too many unfrozen ice packs in the refrigerator? | YES | Take some out. |

Check the temperature the next day. It should fall to between 4°C and 8°C.

If the temperature still rises put the vaccine in another refrigerator or a cold box. Ask a technician for help.

## Spares

Always keep in stock.

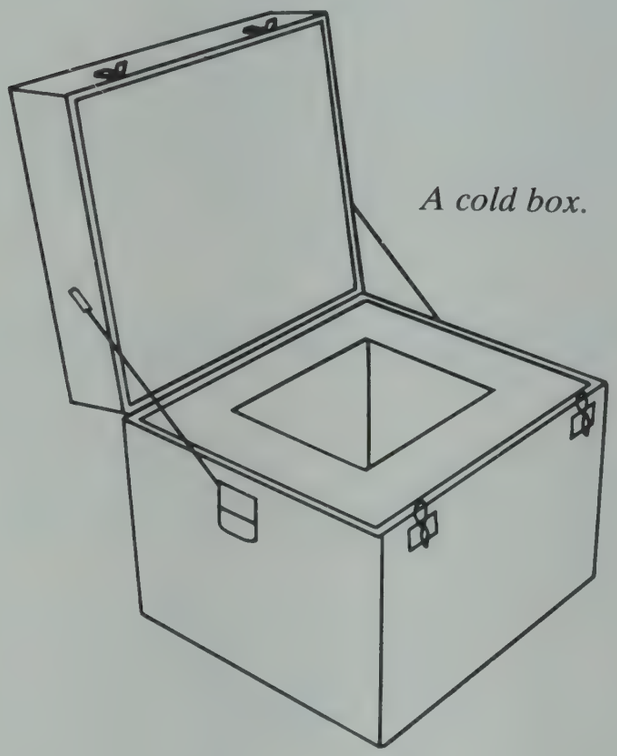
**1.** Spare fuses or fuse wire.

# Section 7

# Cold boxes and vaccine carriers

## Cold boxes

When you take vaccines from one clinic to another you must carry them in a cold box. When you defrost your refrigerator you also need a cold box.



*A cold box.*

## How the cold box keeps vaccines cold

A cold box needs two things to keep vaccines cold.

**Insulation** Insulation is a thick material which lines the walls and lid of a cold box. Insulation does not completely stop heat entering the cold box. Heat and cold pass through the insulation slowly. A metal cold box which reflects the light or a cold box which you have painted white are the best. It is difficult for heat to enter them.

**Ice** The cold box can only keep vaccines cold if there is ice inside. The best way to make ice for the cold box is in ice packs. An ice pack is a flat plastic container with water in it. When you put an ice pack in the freezing compartment of a refrigerator the water turns to ice.

When you put ice packs into a cold box and close the lid, the temperature inside falls to about 4°C. If you keep the box closed and the insulation is good, the ice will take four or five days to melt. During this time the temperature inside the cold box is about 4°C. It is suitable for carrying vaccines. When all the ice melts the temperature rises above 8°C. The vaccines quickly lose their strength and become useless.

Only open the lid of the cold box when it is necessary.

There are two types of ice packs.

**The sealed ice pack**
This has a special liquid inside which you cannot take out.

**The open ice pack**
You can unscrew the cap of the ice pack and fill it with water. Always check that it is full of water. You can use a metal can with a screw cap as an ice pack. But never use glass bottles as they break easily.

When you are not using ice packs in the cold box, keep them in the freezing compartment of the refrigerator. Then they are ready for use. They also keep the refrigerator cold, if it stops working. If you put too many unfrozen ice packs in the freezing compartment at one time the temperature in the refrigerator will rise.

# How to pack the cold box

**1.** Put ice packs in the freezing compartment of the refrigerator two days before you need to use the cold box. Make sure all the ice packs touch the evaporator plate. Then they will freeze quickly. The day before you use the cold box check that the ice packs are frozen.

**2.** You need enough ice packs to line the bottom, sides and top of the cold box.

**3.** Put ice packs in the bottom of the cold box, side by side.

**4.** Put ice packs all around the sides of the cold box.

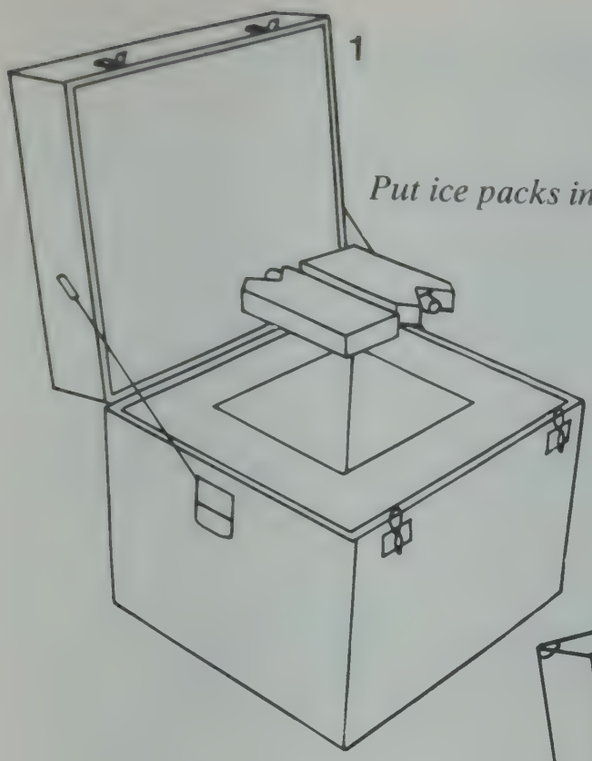
**5.** Put the vaccines into the cold box. The DPT and tetanus toxoid vaccines must not touch the ice packs. If these vaccines become frozen they lose their strength and become useless. Wrap the DPT and tetanus toxoid vaccines in cardboard to protect them. Measles and polio vaccines must be very cold. If you are carrying DPT, measles and polio vaccines, put measles and polio at the bottom of the box next to the ice. Wrap DPT and tetanus toxoid in cardboard and put them on top of the measles and polio vaccines. You can put BCG vaccine anywhere in the cold box.

**6.** Put a thermometer in the cold box.

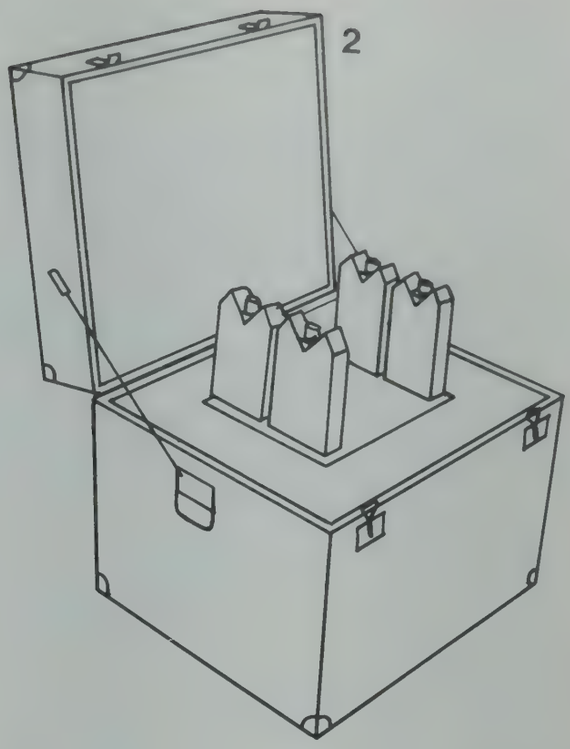
**7.** Put ice packs on top of the vaccines. Put cardboard between the DPT and tetanus toxoid vaccines and the ice packs on top of the box.

**8.** Close the lid tightly.

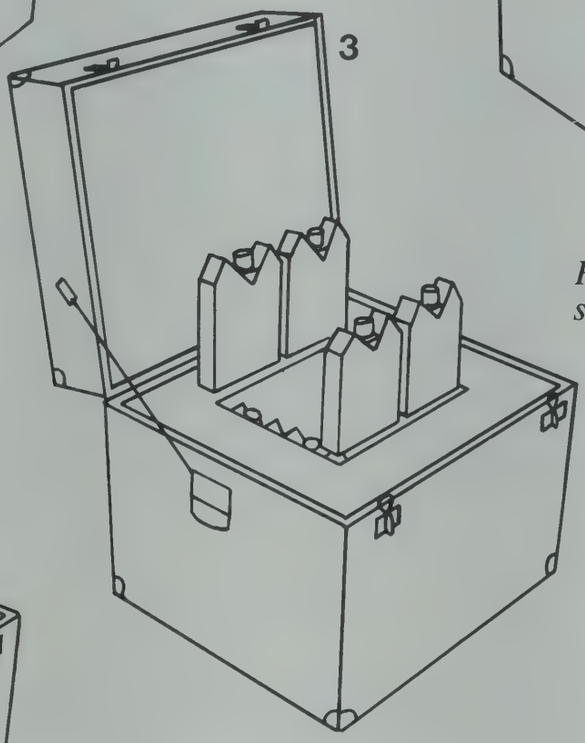
**9.** If you do not have enough ice packs, put the ice packs on the top and sides only.

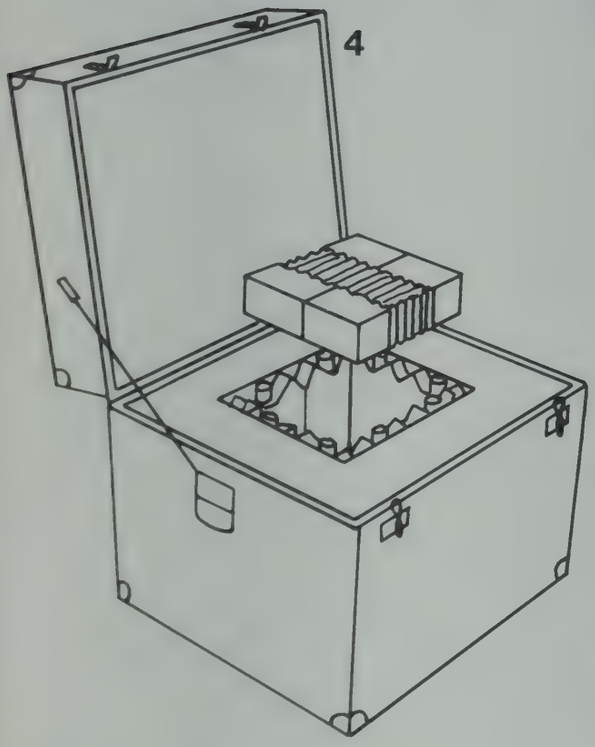



*Put ice packs in the bottom.*

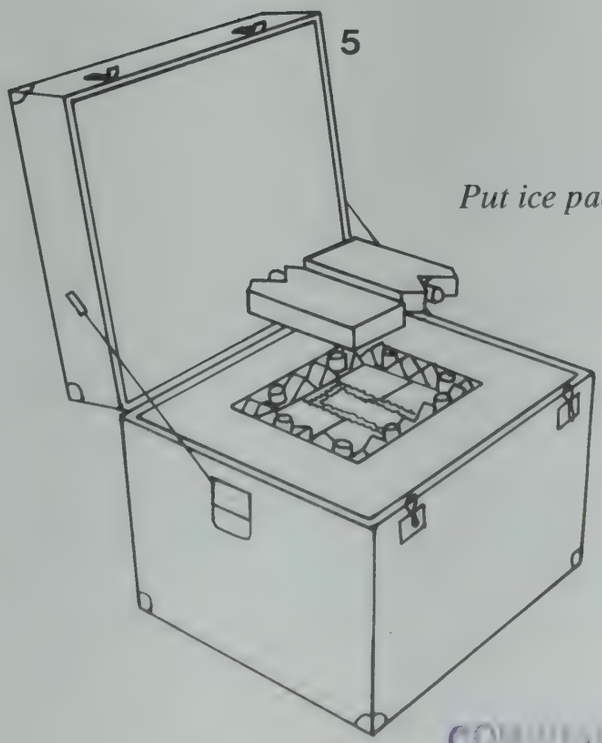



*Put the ice packs all round the sides.*




*Put the vaccines in the cold box.*




*Put ice packs on top.*



337

# How to keep the cold box cold

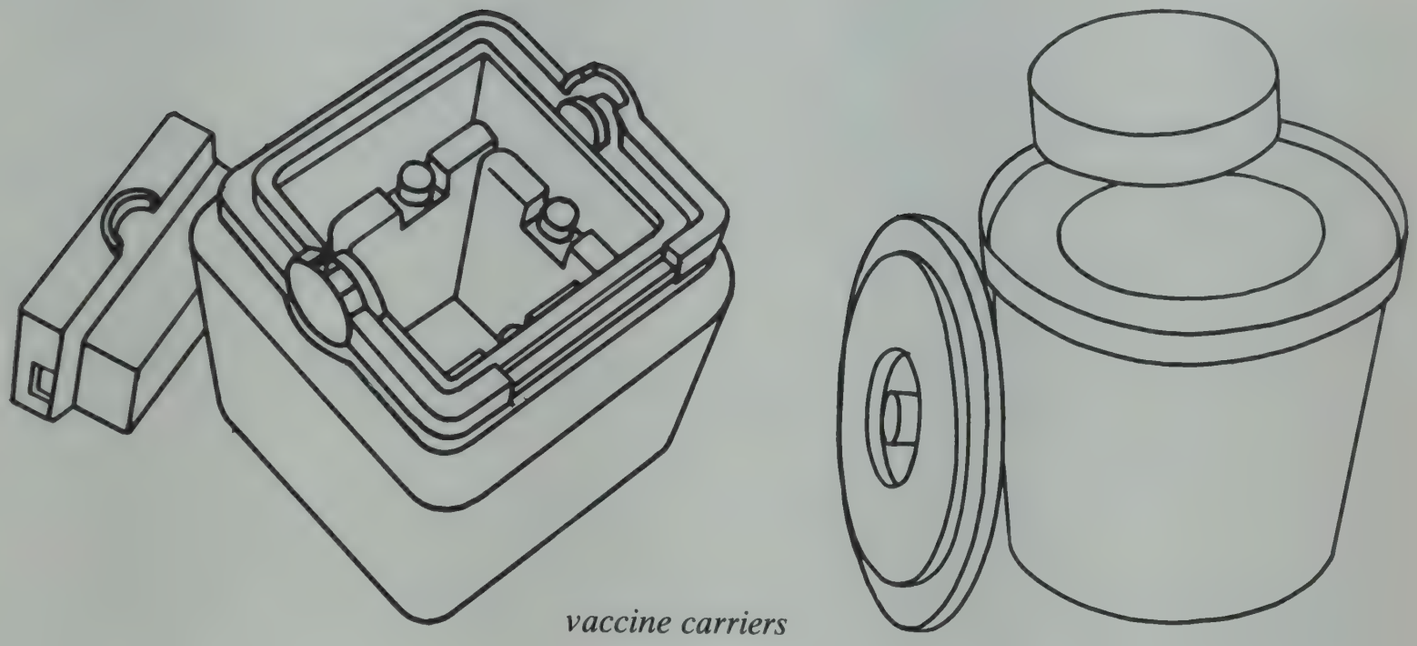
1. Keep the cold box out of the sunlight. Cover it with a large wet cloth. This helps to keep it cold.
2. Open the cold box only when it is necessary. Close it again quickly.
3. When you open the cold box check the temperature. The temperature inside should be between 4°C and 8°C. If the temperature is above 8°C put the vaccines in a refrigerator immediately. If you do not do this the vaccines lose their strength and become useless.
4. When you receive vaccines in a cold box for your store put them in your refrigerator immediately. Put the ice packs in the freezing compartment. Do not put too many ice packs in at one time.

# How to look after your cold box

1. Check that the lid fits tightly.
2. Check the seal around the box. If it is broken, repair it with tape. If it is possible buy a new seal.
3. Look for any cracks inside or outside. If you find any repair them.
4. Never sit on the cold box.
5. Oil the hinges and locks regularly.
6. After you use the cold box wash it with a clean cloth and warm water. Leave the lid open so that it can dry.

# Vaccine carriers

When you carry small quantities of vaccine from the clinic to a village use a vaccine carrier.



*vaccine carriers*

# How the vaccine carrier keeps vaccines cold

The vaccine carrier is small enough to carry by hand, or on a bicycle.

A vaccine carrier needs two things to keep vaccines cold.

**Insulation** Insulation is a thick material which lines the walls and lid of a vaccine carrier. Insulation does not completely stop heat entering the vaccine carrier. Heat and cold pass through the insulation slowly.

You can use a thermos flask to carry vaccines. The glass in a thermos flask is very delicate. It breaks easily so it is not safe to use.

**Ice** The vaccine carrier can only keep vaccines cold if there is ice inside. The best way to make ice for the vaccine carrier is in ice packs. An ice pack is a flat plastic container with water in it. When you put an ice pack in the freezing compartment of a refrigerator the water turns to ice.

When you put ice into a vaccine carrier and close the lid, the temperature inside falls to about 4°C. If you keep the lid closed and the insulation is good, the ice will take three or four days to melt. During this time the temperature inside the vaccine carrier is about 4°C. It is suitable for carrying vaccines. When all the ice melts the temperature rises above 8°C. The vaccines quickly lose their strength and become useless.

Only open the vaccine carrier when it is necessary.

Some vaccine carriers have ice packs which fit into the vaccine carrier. Always check that the ice packs are full of water. When you are not using ice packs in the vaccine carrier, keep them in the freezing compartment of the refrigerator. Then they are ready for use. They also keep the refrigerator cold if it stops working. If you put too many unfrozen ice packs in the freezing compartment the temperature in the refrigerator will rise.

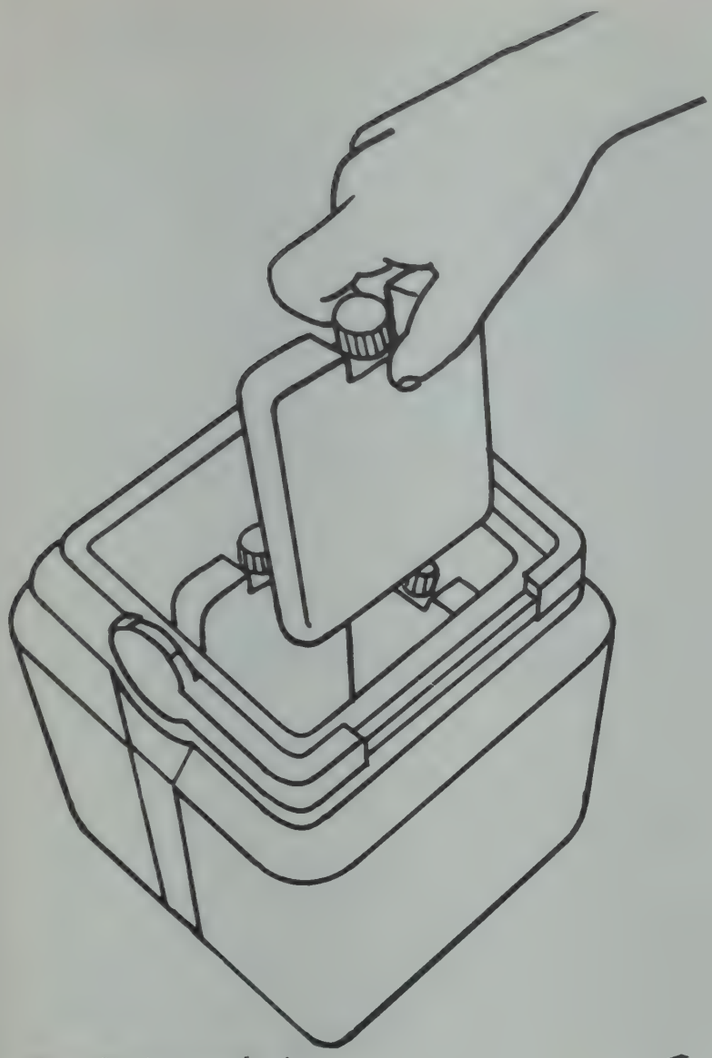
Some vaccine carriers do not have special ice packs. You can use ice in plastic bags to keep the vaccines cold. Make ice in ice-trays in the freezing compartment of your refrigerator and put the ice into plastic bags. Use two plastic bags — one inside the other. Make sure there are no holes in the bags.

# How to pack the vaccine carrier

There are two types of vaccine carrier. One has special ice packs. The other does not have ice packs so you must use ice in plastic bags.

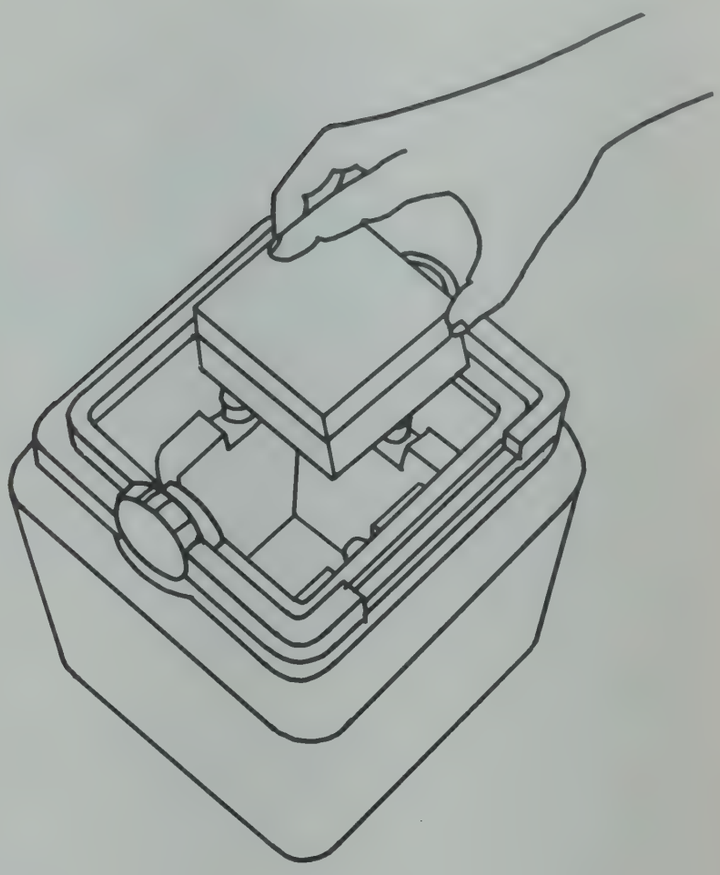
## Vaccine carriers with special ice packs

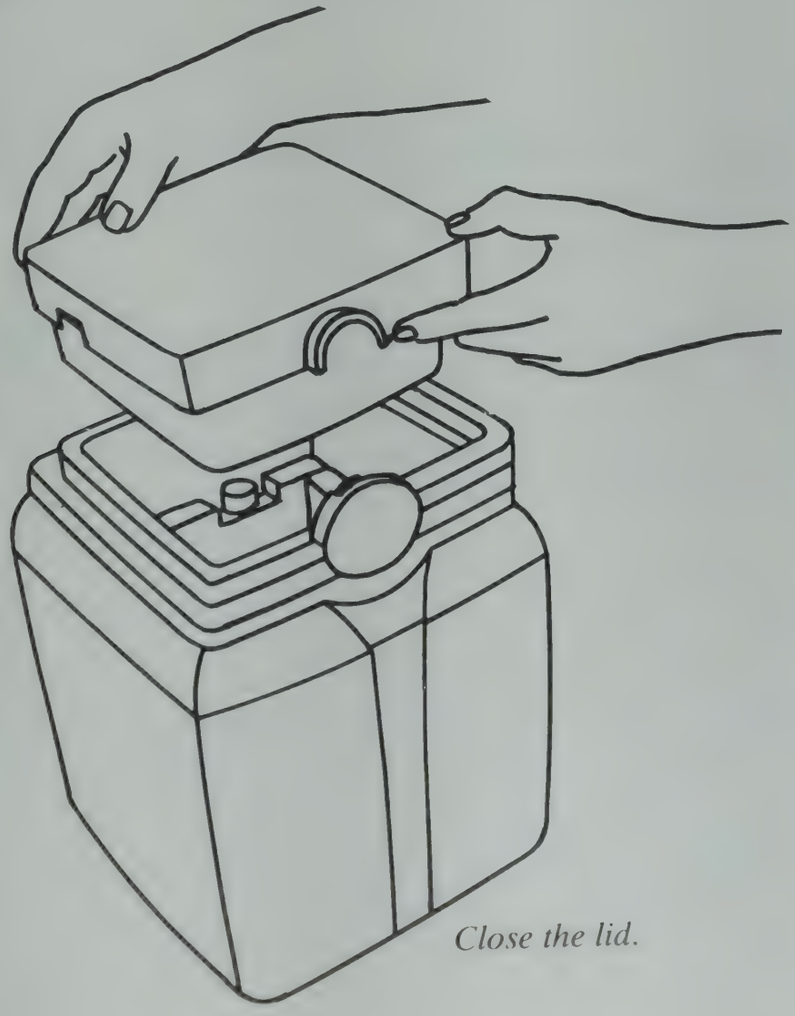
1. You must fill the ice packs with water yourself. Check that you have screwed the top on properly.
2. Put the ice packs in the freezing compartment of the refrigerator two days before you need to use the vaccine carrier. Make sure all the ice packs touch the evaporator plate. Then they will freeze quickly. The day before you use the vaccine carrier check that the ice packs are frozen.
3. Put the ice packs around the sides of the vaccine carrier.
4. Put the vaccines in the vaccine carrier. DPT and tetanus toxoid vaccines must not touch the ice packs. If these vaccines become frozen, they lose their strength and become useless. Wrap DPT and tetanus toxoid vaccines in cardboard to protect them. Measles and polio vaccines must be very cold. If you are carrying DPT, tetanus toxoid, measles and polio vaccines, put the measles and polio at the bottom of the vaccine carrier. Wrap the DPT and tetanus toxoid in cardboard and put them on top of the measles and polio vaccines. You can put BCG anywhere in the vaccine carrier.
5. Put a thermometer in the vaccine carrier.
6. Close the lid tightly.



*Put the ice packs in.*

*Put the vaccines in the carrier.*





*Close the lid.*

**Vaccine carriers without special ice packs**

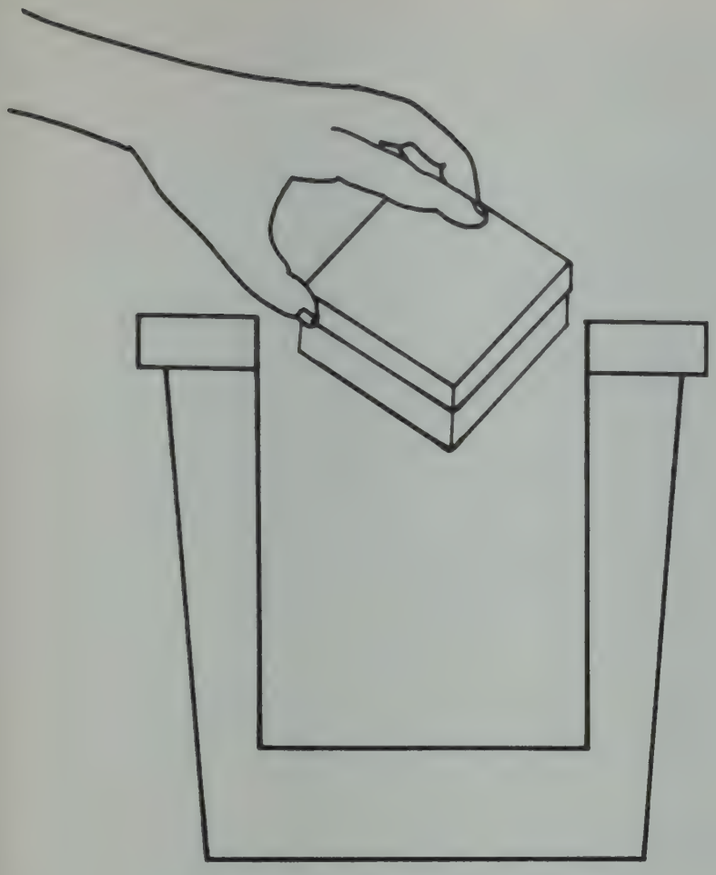
1. The day before you need to use the vaccine carrier check that you have enough ice in the freezing compartment of the refrigerator. Each carrier needs a tray of ice.
2. Put the vaccines in a plastic bag, and put them into the vaccine carrier.
3. If you are carrying measles, polio, DPT and tetanus toxoid vaccines, put the measles and polio at the bottom. Put the DPT and tetanus toxoid on top and wrap them in cardboard to protect them.
4. Put a thermometer in the vaccine carrier.
5. Put the ice from the ice trays in plastic bags. Use two plastic bags — one inside the other. Tie the plastic bags at the top.
6. Put the plastic bag with the ice on top of the vaccines. Do not let the ice touch the DPT or tetanus toxoid vaccines. If these vaccines become frozen they lose their strength.
7. Close the lid tightly.

# How to keep the vaccine carrier cold

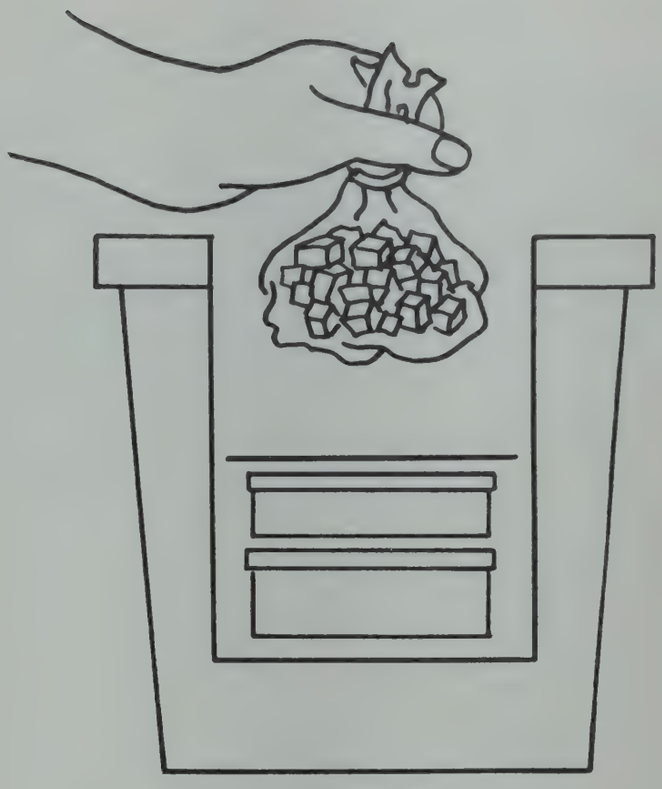
1. Keep the vaccine carrier out of the sunlight.
2. Open the carrier only when it is necessary. Close it again quickly.
3. When you are in the village, vaccinate the children in the shade.
4. When you vaccinate the children take one ice pack out of the carrier. Put the measles and polio vaccines which you are using on top of this. This keeps the vaccines cold. Never put DPT or tetanus toxoid on top of an ice pack.

# How to look after your vaccine carrier

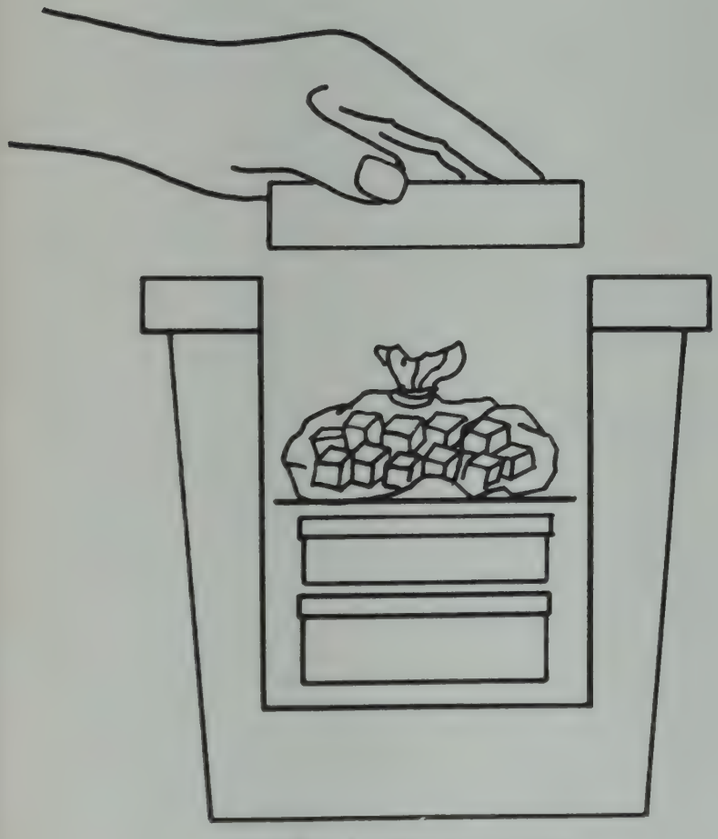
1. Every time you use the vaccine carrier check the inside and outside for cracks. If you find any, repair them.
2. Never sit or lean on the vaccine carrier.
3. After you use the vaccine carrier, wash it with a clean cloth and warm water. Leave the lid open and allow it to dry.



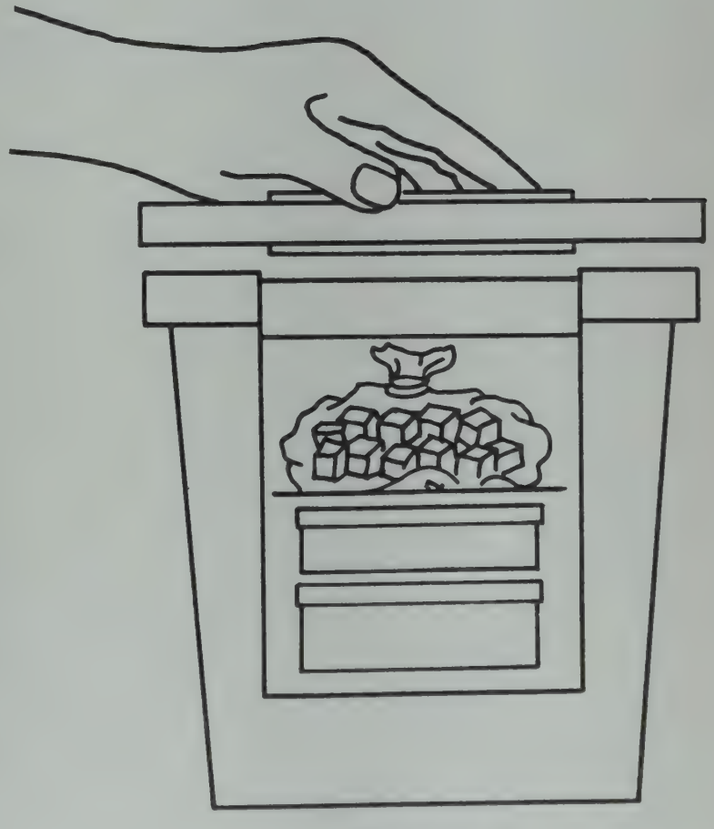
*Put the vaccines in the carrier.*



*Put the ice in.*



*Put in the insulation.*



*Close the lid.*

Month

| Day | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Temperature in the morning °C* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Temperature in the afternoon °C* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Is there ice in the freezing compartment?* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kerosene refrigerators | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Fill the tank* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Clean the burner* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Clean the flue* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Trim the wick* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gas refrigerators<br>*New gas cylinder* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

# Annex I

# Spare parts

You need to keep some spare parts for your refrigerator. There is a list of the parts you may need for different kinds of refrigerators in section 6 on pages 45, 46, 47 and 48. Try to get these parts locally. If you cannot get everything you need, write to the World Health Organization Expanded Programme on Immunization (WHO/EPI) or UNICEF. They may send you the address of someone who can supply the parts. There may be a WHO or UNICEF office in your country. Otherwise you can write to:

**UNICEF**

United Nations
New York
NY 10017
USA

**WHO/EPI**

World Health Organization
CH – 1211 Geneva 27
Switzerland

WHO Regional Office for Eastern Mediterranean
PO Box 1517
Alexandria
Egypt

WHO Regional Office for South East Asia
World Health House
Indraprastha Estate
Ring Road
New Delhi 110002
India

WHO Regional Office for Western Pacific
PO Box 2932
Manila
Philippines

WHO Regional Office for Africa
B P 6 Brazzaville
Republic of Congo

Pan American Health Organization
525 Twenty Third Street NW
Washington DC 20037
USA

# Annex II

# Have your DPT or tetanus toxoid vaccines frozen?

You must never freeze DPT or tetanus toxoid vaccines. If the temperature of DPT or tetanus toxoid vaccines falls below 0°C, these vaccines lose their strength. When the temperature of the vaccines rises again they are useless. It is easy to test for this.

The vaccine is in a small glass bottle. This bottle is called a vial, or an ampoule. If you think the vaccine has frozen shake the vial and leave it in a light place. But keep the vaccine out of sunlight. Wait for 15 minutes.

Now look at the vaccine in the vial. If it looks cloudy and smooth, you can use the vaccine. It is still strong. But if the liquid in the top of the vial is clear, and there is a sediment at the bottom, you must not use the vaccine. It has lost its strength and is useless. You must not use any other vials which may also have lost their strength.

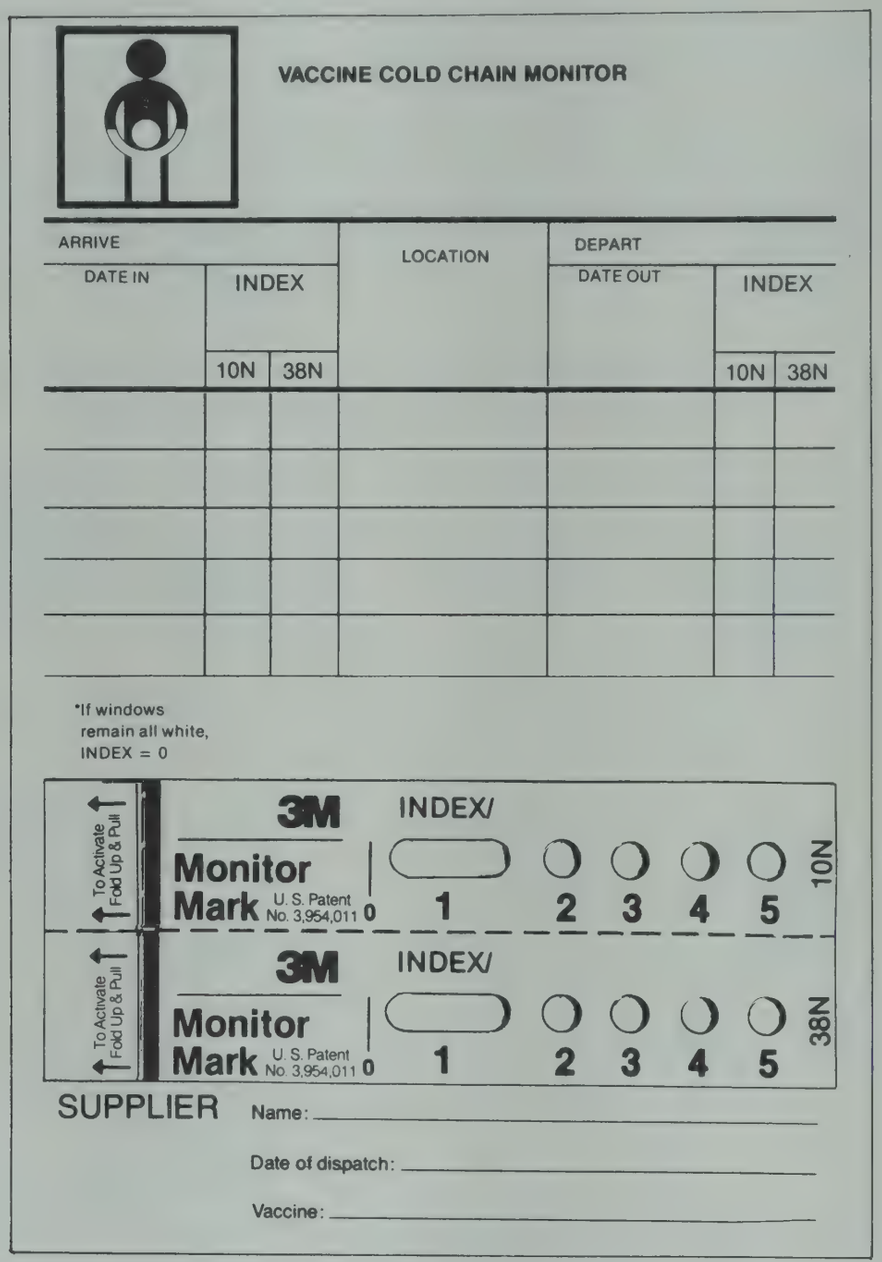
# Have your DPT or tetanus toxoid vaccines frozen?

| | | |
|---|---|---|
| *The temperature of this vaccine was always between 4°C and 8°C* | | *The temperature of this vaccine fell below 0°C* |
| *The liquid is smooth and cloudy* | *Now* | *The liquid contains little particles* |
| *The liquid is still smooth and cloudy* | *After 15 minutes* | *The liquid is clear at the top. There is a sediment at the bottom* |
| *The liquid begins to clear, but there is no sediment* | *After 30 minutes* | *The liquid is clear. There is a thick sediment at the bottom* |
| *This vaccine is still strong. You may use it.* | | *This vaccine is useless. Do* **not** *use it.* |

**Based on WHO/EPI**

# Annex III

# The cold chain monitor



VACCINE COLD CHAIN MONITOR

| ARRIVE | | | LOCATION | DEPART | | |
|---|---|---|---|---|---|---|
| DATE IN | INDEX | | | DATE OUT | INDEX | |
| | 10N | 38N | | | 10N | 38N |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

*If windows remain all white, INDEX = 0

3M Monitor Mark U. S. Patent No. 3,954,011 — INDEX/ 0 1 2 3 4 5 — 10N

To Activate Fold Up & Pull

3M Monitor Mark U. S. Patent No. 3,954,011 — INDEX/ 0 1 2 3 4 5 — 38N

To Activate Fold Up & Pull

SUPPLIER Name: _____

Date of dispatch: _____

Vaccine: _____

*Reproduced courtesy of WHO/EPI*

This annex shows you a new type of monitor. The monitor is usually a yellow card with two lines of white dots. (There is also a card with an Arrive Index and Depart Index.) Under each dot there is a number. The white dots are sensitive to heat. The top line begins to turn blue if the temperature is above 10°C. The bottom one starts to turn blue when the temperature is over 38°C. If the temperature falls below 10°C or 38°C, the colour change stops.

When you receive a supply of vaccine with a monitor you must always check the monitor. If all the dots are white, you can use the vaccines.

If dot number 1 on the top line is blue, you may use the vaccines. But use the oral polio vaccine (OPV) within three months. And make sure your refrigerator works properly.

If all the dots on the top line are blue, the vaccine may have lost some of its strength. Use measles vaccine within three months. Do not use oral polio vaccine until you can test it. It may be useless.

If all the dots on the top line are blue, and dot number 1 on the bottom line is also blue, you must take care. Use DPT and BCG within three months. The oral polio and measles vaccines may have lost their strength. You must test these vaccines before you use them. And make sure your refrigerator works properly.

If all the dots on the card are blue, the vaccines may be useless. Test measles, OPV, DPT and BCG vaccines before you use them.

The numbers on the card are not the temperature of the vaccine. But they tell you if the vaccine is still strong.

If you receive vaccines with a monitor:

**1.** Check the card, to see if the dots are blue on the top line. If they are not blue, write a 0 in the Arrive Index column under '10 N'. '10 N' is the column for the top line of dots. If the dots are blue, look at the biggest number which is blue on the top line. For example, number 3 on the top line. Write this number in the Arrive Index column under '10 N'. Now do the same for the bottom line of dots. '38 N' is the column for this line.

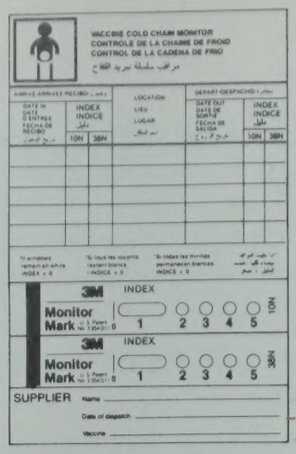
**2.** Also write the date when you received the vaccines in the Date In column.

**3.** Keep this monitor with the vaccines in the refrigerator.

**4.** When you send the vaccines out, send the monitor with them. Before you send the monitor write the biggest numbers which are blue in the Depart Index columns for both lines.

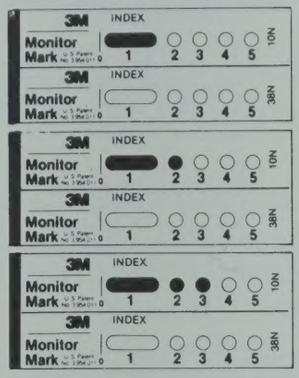
**5.** Write the date in the Date Out column.

You can check your monitor exactly with the picture on the next page.

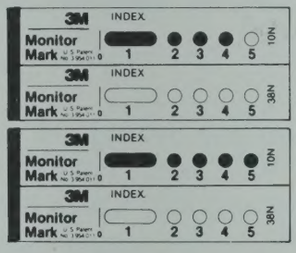



# Check your cold chain monitor!

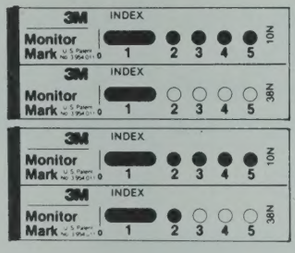
**Cold chain good — use all vaccines**



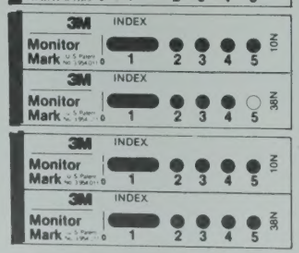

**CHECK** for cold chain failure.
**USE** Oral Polio vaccine within 3 months.




**URGENT**
**CHECK** for cold chain failure.
**USE** Measles vaccine within 3 months.
**TEST** Oral Polio vaccine before use.




**URGENT**
**FIND** an alternative storage facility and investigate cold chain failure.
**USE** DPT and BCG vaccine within 3 months.
**TEST** Measles and Oral Polio vaccine before use.




**URGENT**
**FIND** an alternative storage facility and investigate cold chain failure.
**TEST** Measles, Oral Polio, DPT and BCG vaccine before use.

**The Appropriate Health Resources and Technologies Action Group Ltd.**

AHRTAG is an independent charity set up in 1977. Its objective is to promote new ideas on basic health care through its information service, training materials and design and development of simple equipment.

## Publications:

- 'Low cost aids'
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- 'Low cost physiotherapy aids'
  by Don Caston & Joan Thompson, 45 pp (1982)
- 'Primary health care in developing countries: a guide to resources in the U.K.'
  32 pp (1982)
- 'How to look after a health centre store'
  by Anthony Battersby, gives step-by-step instructions on all aspects of store keeping, 72pp (1983)

## Free publications:

- 'Diarrhoea Dialogue' – a quarterly newsletter on all aspects of diarrhoeal disease control. Also available in French and Spanish.
- 'How to make hand grips' – a poster showing ways in which clay, plaster and epoxy resin putty can be used to make hand grips to allow disabled people to hold tools, spoons and brushes, etc. (1981).
- 'The AHRTAG baby length measurer' – free working drawings for a simple, lightweight, baby length measurer which can be made from wood and taken apart for easy carrying (1982)
- 'How to make an illuminator' – a free leaflet of a simple design for an illuminator which can be used with an oil or candle lamp, battery power, mains electricity or even sunlight (1982)
- Dental health newsletter – bi-annual newsletter promoting dental health care

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